

INTERNATIONAL CODE

OF NOMENCLATURE

OF

BACTERIA and VIRUSES

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International Code of Nomenclature
of
Bacteria and Viruses



BACTERIOLOGICAL CODE



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International Code of Nomenclature of Bacteria and Viruses

BACTERIOLOGICAL CODE



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The Editorial Board of the
**INTERNATIONAL COMMITTEE ON BACTERIOLOGICAL
NOMENCLATURE**

Approved by

The Judicial Commission of the International Committee
on Bacteriological Nomenclature

The International Committee on Bacteriological Nomenclature

The International Association of Microbiological Societies

The Plenary Session of the VI International Congress of Microbiology,
Rome, Italy, September, 1953

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Foreword

Microbiologists who have occasion to use the scientific names of the microorganisms with which they deal generally prefer to use *correct* names and to use them *correctly*. Relatively few authors have special or direct interest in the problems of nomenclature as such, but there is general recognition that acceptance of the same names by various authors is essential in a field such as microbiology which has probably more economic implications than any other subdivision of biology. One is confronted with the fact that the names given to microorganisms have been proposed by individuals whose major interest has been the organisms themselves, not their names. Their economic significance has commonly been stressed. These minute organisms were found in some cases to produce disease in man, animals or plants; their study became basic to the professions of medicine and veterinary medicine; other microorganisms produced fermentation, decay and spoilage; it was found that fundamental studies of cellular physiology and metabolism, cell structure, inheritance, enzymology, photosynthesis, production of antibiotics, preservation of foods and feeds, public health, sanitation, soil fertility, plant pathology, and other fields required some basic knowledge of bacteriology. Those who discovered and worked with these organisms recognized the need of giving names to them, but frequently had little or no experience in scientific nomenclature. What rules should be followed in the coining of these names? Precedents to be followed were not clearly formulated in the early days of bacteriology.

Carl von Linné (Linnaeus) in the latter part of the eighteenth century proposed certain nomenclatural principles which were adopted with surprising unanimity by biologists of his day. Later the botanists and zoologists in separate international meetings and congresses developed two codes of nomenclature, which agreed in most points but differed in some. Many bacteriologists followed the Botanical Code, some the Zoological Code, and others named the organisms which they discovered with scant attention to established rules. It

became evident that rules in Botany formulated primarily by those interested in the taxonomy of flowering plants, ferns and mosses did not fit too well the needs of the bacteriologist.

THE FIRST INTERNATIONAL MICROBIOLOGICAL CONGRESS (1930)

The desire that special attention should be paid to the peculiar needs of bacteriology was voiced at the First International Congress of Microbiology convened in Paris in 1930 by the International Society for Microbiology under the auspices of the Pasteur Institute. As the result of recommendations made by several of the delegates to the Congress, a Commission on Nomenclature and Taxonomy was constituted to prepare and report recommendations to the Plenary Session of the Congress.

The members of this commission were E. Pribram, Chicago, U.S.A., *Chairman*; A. R. Prévot, Paris, France, *Secretary*; R. E. Buchanan, Ames, Iowa, U.S.A.; K. Kiskalt, Germany; J. C. G. Ledingham, London, England; Reiner Müller, Köln, Germany; R. St. John-Brooks, London, England, and I. Yamasaki, Fukuoka, Kyushu, Japan.

Several resolutions prepared by the Commission were approved unanimously by the Plenary Session. These resolutions (in their English text) were as follows:

- I. The founding of the International Society for Microbiology and the establishment of Congresses of Microbiology make possible for the first time adequate international cooperation relative to certain problems of microbial nomenclature. It is clearly recognized that the living forms with which the microbiologists concern themselves are in part plants, in part animals, and in part primitive. It is further recognized that *insofar as they may be applicable and appropriate* the nomenclatural codes agreed upon by international Congresses of Botany and Zoology should be followed in the naming of microorganisms. Bearing in mind however the peculiarly independent course of development that Bacteriology has taken in the past fifty years and elaboration of special descriptive criteria which bacteriologists have of necessity developed, it is the opinion of the International Society for Microbiology that the bacteria constitute a group for which special arrangements are necessary. Therefore, the International Society for Microbiology has decided to consider the subject of Bacterial Nomenclature as part of its permanent programme.
- II. The International Society for Microbiology is of the opinion that the interests of bacterial nomenclature will best be served by placing the subject in the hands of a single International Com-

Foreword

mittee, under the aegis of the International Society for Microbiology, adequately representative of all departments of Bacteriology, on which experts from all spheres of bacteriological research may work together. It is recognized that the subject of bacterial nomenclature is of so wide a nature that unless the personnel of an International Committee formed to deal with it is representative of all aspects of bacteriology, it is not likely to carry weight. Such a representative committee, to be called the Nomenclature Committee for the International Society for Microbiology, is hereby authorized and constituted.

III. The Nomenclature Committee for the International Society for Microbiology shall be constituted as follows:

- a. Two permanent secretaries shall be elected: one primarily to represent medical and veterinary bacteriology, the other primarily to represent the other phases of bacteriology. The following individuals are hereby appointed secretaries.
 - (1) To represent primarily medical and veterinary bacteriology Dr. Ralph St. John-Brooks, Lister Institute, London, England.
 - (2) To represent primarily the other phases of bacteriology Dr. R. S. Breed, Geneva, New York, U.S.A.

Should a secretaryship become vacant, the position may be filled *pro tempore* by choice of the Committee. A permanent secretary should be chosen by action of the next succeeding International Congress for Microbiology.

- b. The remaining members of the Committee shall be appointed by such National Committees of the International Society and by such of the various National Societies affiliated with the International Society as may desire representation thereon. Not more than three members may be thus chosen to represent a single nation. In addition, in order that the Committee shall be truly representative of all interests, the Committee is authorized to add such members as may be deemed desirable.

IV. The duties of the Nomenclature Committee shall include the following:

- a. Through the secretaries the members of the Committee shall be circularized with reference to such problems of bacterial nomenclature as may arise, and shall endeavour to reach an agreement. No action relating to nomenclature shall be considered complete and operative until it has been considered by all members of the Committee, until adequate publicity has been given with respect to actions proposed, until approval

has been given by a majority of two thirds of the members of the Committee, and until a report has been made to the next succeeding International Congress for Microbiology and opportunity thereby given for objection, modification or rejection by action of the Congress.

- b. The Committee shall consider, among others, problems such as criteria to be employed in classification, adoption of names for *species* and *genera conservanda*, type species (including their identification and preservation), the encouragement of monographing of special groups or genera of bacteria by those best qualified to do the work, the enlargement of the scope and usefulness of the various type culture collections by more adequate support, and the preparation and publication of such Committee and Subcommittee reports as may be advisable.
- I. Copies of these resolutions shall be submitted to the appropriate sections of the International Botanical Congress, Cambridge, 1930. It is the hope of the International Congress for Microbiology that the members of the International Botanical Congress who are interested in bacterial nomenclature will see the advisability of the special questions of nomenclature of bacteria being considered by a single international authority and that they will suggest names of members of the Botanical Congress willing to serve on the committee who, in their opinion, would add to its strength and authority.
- II. In view of the adequate provision made for special regulations relating to the bacteria, and the feasibility of designating *genera conservanda* among the bacteria by international agreement, it is believed that the greatest stability will be conferred by the adoption of the publication of *Species Plantarum* by Linnaeus in 1753 as the point of departure for bacterial nomenclature. The adoption of this date is recommended. It is further suggested that no present action be taken with reference to a list of *genera conservanda* for the bacteria.
- III. Among the most important agencies working toward satisfactory nomenclature and classification of bacteria are the several type culture collections. These constitute invaluable repositories and much of the future development of bacteriology will depend upon their adequate growth, support and utilization; in some cases at least they should develop into research institutes of high grade. It is urged that the coordination and cooperation existing among these institutions be extended the better to serve the interests of bacteriology in its theoretical, medical and other economic aspects. It is further urged that all bacteriologists publishing descriptions of new species or important strains of bacteria deposit pure cul-

tures of such with a culture collection that they may be made available to others interested. Particularly is it urged that the adequate financial support of these culture collections by official agencies, by educational and research institutions and by the research foundations constitutes an important and immediate need.

It will be noted that in the action of the Congress the development of an adequate Bacteriological Code was linked with the Botanical Code. The specific suggestion was made that members of the International Botanical Congress, 1930, be apprised of the resolutions passed by the First Microbiological Congress and that the Botanical Congress be asked to cooperate. This was done, and the two secretaries of the International Nomenclature Committee for Bacteriology (Dr. R. St. John-Brooks and Dr. R. S. Breed) were designated by the Botanical Congress as a special committee on the nomenclature of bacteria.

THE SECOND INTERNATIONAL CONGRESS FOR MICROBIOLOGY (London, 1936)

The International Committee met during the sessions of the second International Congress for Microbiology in London in 1936. Proposals by R. E. Buchanan and H. J. Conn to conserve the generic name *Bacillus* Cohn 1872, to designate as the type species *Bacillus subtilis* Cohn 1872, and to fix the type or standard culture as the 'Marburg strain' were approved by the Committee and by the Plenary Session of the Congress.

A further specific action of the Nomenclature Committee and of the London Congress had to do with the duplication of generic names in the *Protista*, the group ordinarily defined to include the protozoa, algae, fungi and bacteria. Inasmuch as bacteria are usually included among the plants, and subsequent plant homonyms are regarded as illegitimate, the principal interest is the suppression as illegitimate later homonyms in the protozoa and the bacteria. Prof. F. Mesnil proposed and the Nomenclature Committee and the Congress agreed that generic homonyms are not permitted in the group *Protista*; further that it is advisable to avoid homonymy amongst *Protista* on the one hand, plants or animals (*Metazoa*) on the other.

The Committee and Congress also acted favorably on a proposal by Prof. R. S. Breed relative to non-capitalization of specific epithets in names of species of bacteria.

"Bacteriologists should accept Article 13 of the International Rules of Zoological Nomenclature, as follows:

'While specific substantive names derived from names of persons may be written with a capital initial letter, all other specific names are to be written with a small initial letter.'

At this 1936 (London) meeting of the International Committee it

was agreed that, before the convening of the third International Congress of Microbiology to be held three years later in New York, a tentative Code of Bacteriological Nomenclature should be drafted and presented for the consideration of the Committee. To facilitate easy conference an American (Canadian and U.S.A.) Subcommittee was constituted to prepare such a tentative code. The members of this Subcommittee were R. E. Buchanan, Chairman; Robert S. Breed; J. Howard Brown; I. C. Hall; W. L. Holman; E. G. D. Murray; and Otto Rahn.

The chairman was asked to assemble material for consideration by the members. A mimeographed brochure of 119 pages was prepared under the title "Rules of Nomenclature, Annotated". It consisted of two parallel columns. In the first column the International Rules of Botanical Nomenclature, including *Principles, Rules, Recommendations, Notes and Examples* were printed. In the second column were listed suggestions for a code of Bacteriological Nomenclature formulated by making such minor modification of the Botanical Code as seemed desirable, as by dropping of inapplicable sections. In numerous footnotes were given the pertinent sections of the International Rules of Zoological Nomenclature and the American Code of Entomological Nomenclature. This material was sent to all members of the Subcommittee and to a large number of other bacteriologists, including members of the International Committee insofar as they could be reached. Criticisms and suggestions were invited. More than 30 sets of comments and suggestions were received. These comments were broken up into sections corresponding to those of the suggested code, and the proposed code and comments again submitted to the members of the Subcommittee in the form of a mimeographed booklet under the title "Suggestions and Comments on 'Rules of Nomenclature, Annotated' ". A new series of comments and suggestions was secured from the numerous collaborators, tabulated and submitted once more to the Subcommittee. A final revision was prepared to present to the International Committee at its New York meeting in 1939. The text of this tentative code differed from the basic Botanical Code principally in the following:

- a. A reorganization of the text of the code under the following headings.
 1. General Considerations; 2. General Principles; 3. Rules of Bacteriological Nomenclature with Recommendations; 4. Provisions for interpretation and modification of rules.
- b. Elimination of items and sections of the Botanical Code which seemed inapplicable to bacteriology.
- c. Simplification where possible through rephrasing.
- d. Selection of examples where possible from bacteriology.

THE THIRD INTERNATIONAL MICROBIOLOGICAL CONGRESS
(New York, 1939)

The proposed tentative code was considered at some length by the International Committee for Bacteriological Nomenclature at its New York meeting; many suggestions developed. The report was also presented to one of the sections of the Congress, and about one hundred copies of the "Annotated" and "Tentative" codes distributed.

Upon recommendation of the International Committee on Bacteriological Nomenclature the Plenary Session of the Third International Congress for Microbiology on Sept. 9, 1939 approved the following resolution:

1. That a recognized Bacteriological Code be developed.
2. That publication of such a proposed Code when developed be authorized with the proviso that it shall be regarded as wholly tentative, but in the hope that it shall be widely tested so that it may be brought up for further consideration and final disposition at the next Microbiological Congress which should normally take place in 1942.
3. That the Nomenclature Committee, as at present constituted, shall continue to function under the auspices of the International Association of Microbiologists* as it did under the International Society for Microbiology.
4. That the International Committee shall select from its membership a Judicial Commission consisting of twelve members, exclusive of members *ex officio*, and shall designate a Chairman from the membership of the Commission. The two Permanent Secretaries of the International Committee on Bacteriological Nomenclature shall be members *ex officio* of the Judicial Commission. The commissioners shall serve in three classes of four commissioners each for nine years, so that one class of four commissioners shall retire at every International Congress. In case of resignation or death of any commissioner, his place shall be filled for the unexpired term by the International Committee at its next meeting.

The functions of the International Committee on Bacteriological Nomenclature were more accurately defined as follows:

- a. To consider and pass upon all recommendations relating to the formation or modification of Rules of Nomenclature. The Committee will recommend such action as may be appropriate to the next Plenary Session of an International Congress

* The new name approved for the international organization sponsoring microbiological congresses.

for Microbiology.

- b. To consider all Opinions rendered by the Judicial Commission. Such Opinions become final if not rejected at the meeting of the International Committee next following the date on which the Opinion was issued.
- c. To designate official Type Culture Collections.
- d. To receive and act upon all reports and recommendations received from the Judicial Commission or other committees relating to problems of nomenclature or taxonomy.
- e. To hold at least one meeting triennially in connection with the meeting of the International Congress for Microbiology.
- f. To report to the final Plenary Session of each Congress a record of its actions, and to recommend for approval such actions as require the approval of the Congress.
- g. To cooperate with other Committees, particularly those of the International Botanical and Zoological Congresses, to consider common problems of nomenclature.

The functions of the Judicial Commission of the International Committee on Bacteriological Nomenclature were also defined as follows:

- a. To issue formal *Opinions* when asked to interpret rules of nomenclature in cases in which the application of a rule is doubtful.
- b. To prepare formal *Opinions* relative to the status of names which have been proposed, placing such names when deemed necessary in special lists, such as lists of *Nomina Conservanda*, *Nomina Rejicienda*, etc.
- c. To develop recommendations for emendations of the International Rules for Bacteriological Nomenclature for presentation to the International Committee.
- d. To prepare formal *Opinions* relative to types, particularly types of species and genera, and to develop a list of bacterial genera which have been proposed with the type species of each.
- e. To prepare and publish lists of names of genera which have been proposed for bacteria, for protozoa, or for other groups in which microbiologists are interested in order to assist authors of new names in avoiding illegitimate homonyms.
- f. To develop a list of publications in microbiology whose names of organisms shall have no standing in bacteriology in determination of priority.
- g. To edit and publish the International Rules of Bacteriological Nomenclature, Opinions, Lists of *Nomina Conservanda*, *Nomina Rejicienda*, Type Species, etc.
- h. To report to the International Committee at its triennial meetings all Recommendations, Transactions and Opinions.

- i. To report to the International Committee at its triennial meetings the names of all Commissioners whose terms of service expire, likewise a list of all vacancies caused by resignation or death.

Recommendation. Whenever, in the opinion of any microbiologist an interpretation of any rule or recommendation is desirable because the correct application of such a rule or recommendation is doubtful, or the stability of nomenclature could be increased by the conservation or by the rejection of some name which is a source of confusion or error, it is recommended that he prepare a brief outlining the problem, citing pertinent references and indicating reasons for and against specific interpretations. This brief should be submitted to the Chairman of the Judicial Commission; if desired, through one of the Permanent Secretaries. An Opinion will be formulated, which may not be issued until it has been approved by at least eight members of the Commission.

It was further voted:

That the Proposed International Rules of Bacteriological Nomenclature, in so far as they have been developed by the American-Canadian Committee on Compilation of Proposals on Bacteriological Nomenclature for the International Committee and modified by action of that Committee, shall be referred for final emendation and publication to the Judicial Commission in accordance with Provision (c) above as recorded.

The minutes of the International Committee contain the following statements relative to the Judicial Commission:

With regard to the constitution of the Judicial Commission, members of the Committee present were requested to give its Secretaries lists of persons that they wished to nominate as members of the Judicial Commission, and the Secretaries were requested to transmit such nominations to the entire Committee for ballot, giving members the option of substituting other names if they so desired. It was agreed that after the final ballot the four persons receiving the greatest number of votes should be elected for the nine-year period and that the four persons receiving the smallest number of votes should be elected for the three-year period. The remaining four are to serve for a six-year period.

Nominations to membership on the Judicial Commission were made by the membership of the International Committee in attendance at the New York meeting. The Permanent Secretaries then conducted a mail ballot, resulting in the election of twelve members (Commissioners) and designation of R. E. Buchanan as Chairman.

R. S. Breed and R. St. John-Brooks as Permanent Secretaries of the International Committee also became *ex officio* members and Permanent Secretaries of the Commission.

The records of the Congress showed a membership of 62 on the International Committee on Bacteriological Nomenclature as of August 1939. There were representatives of Microbiological Societies of 24 nations as follows: Argentina, Australia, Belgium, Brazil, Bulgaria, Canada, Denmark, Deutsches Reich, Eire, France, Great Britain, Holland, Hungary, Italy, Norway, Palestine, Poland, Roumania, Spain, Sweden, Switzerland, United States of America, Union of Soviet Socialist Republics, and Uruguay.

It was expected that the mandate of the Congress to the Judicial Commission to develop and publish a tentative proposal for a Code of Bacteriological Nomenclature would be followed promptly. The final determination of the constitution of the Judicial Commission itself was long delayed because of the outbreak of World War II while the New York Congress was in session. It soon proved impracticable to circulate copies of the nomenclatural proposals and to secure comments from all members of the Commission.

Dr. Ralph St. John-Brooks of the Lister Institute, London, one of the Permanent Secretaries of the International Committee in March 1942, spent some days with the Chairman of the Commission in conference and in editing the manuscript which had been reviewed by the Committee at the New York City meeting.

THE FOURTH INTERNATIONAL MICROBIOLOGICAL CONGRESS (Copenhagen, 1947)

The Proposed Bacteriological Code of Nomenclature as authorized by the Third International Congress for Microbiology was printed in June 1947 in a limited edition for distribution and for use by the Judicial Commission and the International Committee at the Fourth International Congress in September 1947.

At the Copenhagen Meeting the proposed Code was considered, revised, and approved for publication by the Judicial Commission, the International Committee and the Plenary Session of the Congress. The English text was published in March 1948 in the *Journal of Bacteriology*, later (Sept. 1949) in the *Journal of General Microbiology*. A Spanish translation (1949) by Prof. Verna was published in Argentina in *De Archivos de Farmacia y Bioquímica del Tucumán* and a German translation by Dr. med. Hubert Bloch (1950) in the *Schweizerische Zeitschrift für allgemeine Pathologie und Bakteriologie*. A French translation by Dr. Prévot and a Japanese translation were also issued.

THE FIFTH INTERNATIONAL MICROBIOLOGICAL CONGRESS (Rio de Janeiro, 1950)

Meetings of the Judicial Commission and of the International Committee were held at Rio de Janeiro and Petropolis (Brazil) in August 1950. Among the important actions of these bodies, confirmed by the Plenary Session of the Congress, were the following:

1. An Editorial Board was established consisting of the Chairman of the Judicial Commission and the two Permanent Secretaries.
2. Publication of a quarterly "International Bulletin of Bacteriological Nomenclature and Taxonomy" was authorized; to be edited by the Editorial Board.
3. Agreement was reached that some revision of the International Bacteriological Code of Nomenclature was desirable and the Judicial Commission instructed to incorporate certain amendments approved, and to prepare recommendations for the 1953 International Microbiological Congress to be held in Rome.

The actions taken by the Commission, the Committee and the Fifth Congress are reported in Volume One "The International Bulletin of Bacteriological Nomenclature and Taxonomy."

In preparation for the Rome Congress (September 1953) the provisional agenda for the meetings of the International Committee and of the Judicial Commission were prepared and published in the June (1953) issue of the International Bulletin.

THE SIXTH INTERNATIONAL MICROBIOLOGICAL CONGRESS (Rome, 1953)

The Editorial Board prepared a series of "Proposals Relative to Emendation and Publication" of a revised International Bacteriological Code of Nomenclature (International Bulletin 1953 pp. 31-63) which recommended publication of the revised Code, suggested that the Rules and Recommendations be adequately annotated, and that there be noted significant resemblances to the Botanical and Zoological Codes of Nomenclature and likewise important differences between them. The hope was expressed that texts in other languages could be published simultaneously with the English text. In all, sixty draft proposals for amendment, deletions and modifications of the Code were submitted and acted upon.

The Judicial Commission, through the Editorial Board, was directed to edit, annotate, and publish the Code as finally approved by the International Committee and the Plenary Session.

The name of the Code was fixed as The International Code of Nomenclature of Bacteria and Viruses.

The manuscript for the Code in original draft form, including Annotations and Appendices, was submitted for editorial suggestions

to all members of the Judicial Commission and to about twenty-five bacteriologists experienced in nomenclature and taxonomy. Unfortunately the preparation of the text and annotations has been so time-consuming that it has not been possible to include texts of the Code in the several important languages of science. It is to be hoped that this may be done in future printings.

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Preface

The history of the development of the 1958 Revised Edition of the International Code of Nomenclature of Bacteria and Viruses has been given in the Foreword. Here it is fitting that there be acknowledgement of the generous assistance given by many individuals and organizations in the preparation and editing of this Code.

The task of developing a wholly satisfactory Bacteriological Code is not complete. New problems involving nomenclature of the bacteria will arise and will require solutions. There have as yet been no final recommendations and no conclusions as to what special Rules and Recommendations will be needed to make functional any proposals to be made by the International Subcommittee on Taxonomy of the Viruses relative to virus nomenclature. The increasing use of terminologies applicable to strains and groups of bacteria of infrasubspecific rank makes necessary careful study of the best methods for preventing confusion, even some degree of nomenclatural chaos, in the naming of taxa of lower rank than subspecies. The growing recognition of the value of the type concept in standardization of names may mean the incorporation into the Code of a definition of Type Culture Collections and their functions in stabilization of bacteriological nomenclature.

A reading of the Annotations of the several Rules and Recommendations of the Bacteriological Code reveals a variance in terminology (sometimes in basic concepts) in the three Biological Codes of Nomenclature (Botanical, Zoological and Bacteriological). These differences have come about through the peculiarly independent development and history of Botany and of Zoology. The organization which can facilitate any attempt to reconcile these interdisciplinary differences must represent biology as a whole and on an international basis. The International Union of Biological Sciences would seem to be the agency able in some effective manner to develop fruitful consultations among the nomenclatural commissions of the three disciplines.

The Editorial Board and the Judicial Commission are most grateful for the generous subventions that have made possible publication of this revised Bacteriological Code. Organizations particularly helpful have been the International Union of Biological Sciences, the

Society of American Bacteriologists, and the Society for General Microbiology. The Iowa State College has likewise been most generous in its provision of office facilities.

The Editorial Board is grateful also for permission given by the Commissions concerned to quote from the International Code of Botanical Nomenclature and from the International Code of Zoological Nomenclature where it has been desirable to compare resemblances and differences between these Codes and the text of the revised International Code of Nomenclature of Bacteria and Viruses. However, the final text of the International Code of Zoological Nomenclature had not been adopted in final form at the time of publication of the International Code of Nomenclature of Bacteria and Viruses (June, 1958). In consequence some quotations may not represent final action by the 1958 Zoological Congress. If there are here included unintentional misinterpretations, they will be corrected in later editions of the Bacteriological Code.

The manuscript for the Code in original draft form, including annotations and appendices, was submitted for editorial suggestions to all members of the Judicial Commission and to about thirty other bacteriologists experienced in nomenclature and taxonomy. The suggestions received were reviewed by the Judicial Commission. The Code represents a high degree of international cooperation. The Editorial Board wishes to express its real appreciation for the helpful cooperation received.

The Editorial Board

R. E. BUCHANAN, *Chairman*

S. T. COWAN, *Secretary*

T. WIKEN, *Secretary*

W. A. CLARK, *Secretary*

(resigned 1 April 1957)

(appointed 8 October 1957)

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CHAPTER 1

General Considerations

General Considerations

GENERAL CONSIDERATION 1. The progress of bacteriology can be furthered by a precise system of nomenclature which is properly integrated with the systems used by botanists and zoologists and accepted by the majority of bacteriologists in all countries. The Bacteriological Code applies to bacteria, related organisms and the viruses. Botanical and Zoological Codes provide for the nomenclature of certain other microbial groups such as the yeasts and fungi, algae and protozoa. The special nomenclatural problems of these groups require cooperation with zoologists and botanists.

ANNOTATIONS*

General Consideration 1. The Botanical Code states (Preamble): Botany requires a precise and simple system of nomenclature used by botanists in all countries, dealing on the one hand with the terms which denote the ranks of taxonomic groups or units, and on the other hand with the names which are applied to the individual taxonomic groups.

No court is competent to enforce the provisions of any nomenclatural code. Adherence to the provisions of the Bacteriological Code is left to the individual judgment of the microbiologist. Nonconformity seems to be due more to lack of knowledge of the Code or to lack of understanding of its intent than to fundamental disagreement with the provisions themselves.

There are three official codes of nomenclature, one for each of the three segments of biology: botany, zoology and bacteriology (including virology). The existence of the three codes is troublesome, for the microbiologist works with microorganisms whose nomenclature is determined by the Bacteriological Code (the bacteria and viruses),

* These annotations are quite unofficial. They are intended to be helpful in the interpretation of the Rules and Recommendations, by giving examples and by noting corresponding Rules and Recommendations to be found in the Botanical and Zoological Codes.

by the Botanical Code (the fungi, algae and slime molds) and by the Zoological Rules (the protozoa). Fortunately, the more important rules of the three codes are similar; differences are reasonably clear but must be understood. The rules and recommendations of this Bacteriological Code for the most part agree with those of the Botanical Code; wherever there are noteworthy differences between the provisions of the Bacteriological and the Botanical or Zoological Codes, they are noted in the appended *Annotations*. Should the rules and recommendations of the several codes prove to be in conflict and lead to doubt as to the correctness or legitimacy of a name, *General Consideration 1* suggests provisions for coordination through consultation with the appropriate representative committees of botanists or zoologists. Botanists, through action of International Botanical Congresses and the International Bureau for Plant Taxonomy and Nomenclature have organized special committees and subcommittees to work on problems relating to particular groups, for example the algae, the fungi, the lichens and the bacteria. Certain microbiological problems can be referred to such committees for advice or for action. The Zoological Rules also provide for committees of specialists to consider and make recommendations relative to problems of the several subdivisions of the animal kingdom. The Judicial Commission of the International Committee on Bacteriological Nomenclature is directed to work actively with the corresponding committees in zoology and botany on matters of common interest.

A related statement in the International Rules of Zoological Nomenclature is:

The object of the Rules is to provide a system under which the name of each taxon is unique and distinctive. A primary purpose is to insure the stability and universal acceptance of names. The Rules do not trespass on freedom of taxonomic practice.

General Consideration 2.

GENERAL CONSIDERATION 2. The precepts on which this system of bacteriological and viral nomenclature is based are divided into Principles, Rules and Recommendations.

Principles (Chapter 2) form the basis of the rules and recommendations.

Rules (Chapter 3) are designed

- (a) to make effective the principles given in Chapter 2,
- (b) to put the nomenclature of the past in order, and
- (c) to provide for the nomenclature of the future.

The rules in general are retroactive; names or forms of nomenclature contrary to a rule (illegitimate names or forms) cannot be maintained. Certain rules authorize appendices and define their scope and authority.

Recommendations deal with subsidiary points, their object being to bring about greater uniformity and clearness, especially in future nomenclature; names or forms contrary to a recommendation cannot on that account be rejected, but they are meant to prevent a repetition of undesirable procedures of the past. Recommendations are appended to the rules which they supplement. Notes attached to rules or recommendations are intended to be explanatory or illustrative and have the same force as the rules or recommendations to which they are appended.

ANNOTATIONS

General Consideration 2. The *Principles* may be regarded in a sense as the constitutional background of the *rules*, *recommendations*, *notes*, *appendices*, *lists*, etc. They are not rules, but may be useful in interpretation, helpful in promoting a better understanding of the rules, and in the solution of problems not covered specifically by them. In theory at least there should be no conflict between the rules and the principles.

The *Rules* are the laws which determine the correctness of names which have been given in the past and constitute a guide to the giving of new names. The corresponding rule of the Botanical Code reads in part:

They are always retroactive except when expressly limited.

The *Appendices* supplement the rules. In them are listed Opinions and various groups of conserved and rejected names; they also include discussions and material too lengthy for convenient incorporation directly into the rules or the recommendations.

The *Recommendations* include the directives of good usage. Authors show good taste and judgment when they propose names that conform to recommendations. In some cases the Bacteriological Code authorizes the correction of names which do not conform to a particular recommendation. However, the provision that non-conformity to a recommendation is not sufficient cause for rejection of a name should be emphasized.

The Botanical and Bacteriological Codes are in essential agreement in their definitions of Principles, Rules and Recommendations.

GENERAL CONSIDERATION 3. Provisions (Chapter 4) for emendations of rules, for special exceptions to rules, and for their interpretation in doubtful cases have been made through the establishment of an International Committee on Bacteriological Nomenclature for the International Association of Microbiological Societies and of its Judicial Commission.

ANNOTATIONS

General Consideration 3. Chapter 4 (p. 123) includes *Provisions* made for selection of a large committee with representation from all countries having microbiological societies which desire representation. This International Committee on Bacteriological Nomenclature (or more briefly, the Nomenclature Committee) elects a Judicial Commission of twelve, to which the two permanent secretaries of the Committee are added, making a total membership of fourteen. Chapter 4 assigns to the Nomenclature Committee and the Judicial Commission many legislative, judicial and editorial functions. The Nomenclature Committee was authorized and organized in 1930, the Judicial Commission in 1939.

The Nomenclature Committee has appointed several subcommittees to consider the problems of certain taxonomic groups.

Botanists, by action of International Botanical Congresses, have developed a Nomenclature Section, several Nomenclature Committees and an affiliated International Association for Plant Taxonomy and Nomenclature.

The zoologists have a corresponding but somewhat different series of legislative and judicial agencies authorized by the several International Zoological Congresses.

See Chapter 4 and its Annotations for details.

CHAPTER 2

Principles

CHAPTER 2

Principles

PRINCIPLE 1. The essential points in nomenclature are

(1) to aim at fixity of names;

(2) to avoid or to reject the use of names which may cause error or ambiguity or throw science into confusion.

Next in importance is the avoidance of all useless creation of names. Other considerations, such as absolute grammatical correctness, regularity, or euphony of names, more or less prevailing custom, regard for persons, etc., notwithstanding their undeniable importance, are relatively accessory.

PRINCIPLE 2. In the absence of a relevant rule, or where the consequences of rules are doubtful, established custom must be followed. In doubtful cases a résumé in which all pertinent facts are outlined should be submitted to the Judicial Commission for an Opinion.

PRINCIPLE 3. Bacteriological nomenclature and botanical nomenclature are interdependent in the sense that the name of a bacterial taxon is to be rejected if it is a later homonym of the name of any plant taxon. Likewise, nomenclature of bacteria and protozoa are interdependent: the name of a bacterial taxon is to be rejected if it is a later homonym of the name of a protozoan taxon. Bacteriological nomenclature is independent of zoological nomenclature (protozoology excepted): the name of a bacterial taxon is not to be rejected simply because it is identical with the name of a taxon in the animal kingdom.

ANNOTATIONS

Principle 1. This principle is similar in phraseology to the statement in the Preamble of the Botanical Code. It is basic to the interpretation of the rules of nomenclature.

The corresponding statement of the Zoological Rules is:

A primary purpose is to insure the stability and universal acceptance of names.

Principle 2. For comment on the format of a request for an Opinion, see Provision 5 (p. 131).

Principle 3. The Botanical Code (Principle I) states:

Botanical nomenclature is independent of zoological nomenclature in the sense that the name of a plant must not be rejected merely because it is identical with the name of an animal.

Article 45 of the Botanical Code reads in part as follows:

If a taxon is transferred from the animal to the plant kingdom, its name or names valid* under the International Rules of Zoological Nomenclature and validly published in the form provided in the Botanical Code (except that for algae, validity under the zoological rules only is required) shall be automatically accepted as having been validly published under this Code at the time of its valid publication as the name of an animal.

The corresponding Article 1 of the Zoological Rules reads:

Zoological nomenclature is independent of botanical nomenclature in the sense that the name of an animal is not to be rejected simply because it is identical with the name of a plant. If, however, an organism is transferred from the vegetable to the animal kingdom, its botanical names are to be accepted in zoological nomenclature with their original botanical status; and if an organism is transferred from the animal to the vegetable kingdom, its names retain their zoological status for purposes of homonymy.

The Zoological Rules also include the following recommendation:

Avoid introducing into zoology a generic name used in botany.

It would be well to avoid proposal of new names of taxa in bacteriology that have been used in zoology.

* The word "valid" in the International Rules of Zoological Nomenclature is equivalent to "legitimate" in the International Code of Botanical Nomenclature.

Principle 4.

PRINCIPLE 4. Scientific names of all taxonomic groups (taxa) are usually taken from Latin or Greek. When taken from any language other than Latin, or formed in an arbitrary manner, they are treated as if they were Latin. Latin terminations should be used so far as possible for new names.

ANNOTATIONS

Principle 4. The meaning of the phrase “usually taken from Latin or Greek” is made clear by prevailing custom. The phrase does not mean that only those Latin and Greek words as found in the dictionaries and lexicons may be used, but that new words proposed as names or epithets may also be coined from the stems of these words singly or as compounds. It is assumed that the classic tradition for the forming of new names will be followed.

Appendix A may be used as a guide for the transcription of Greek into Latin form and for the use of the appropriate Latin gender endings, as prescribed in the last sentence of this Principle.

This statement is a Principle and not a Rule. The Botanical Code, from which this Principle was taken, has altered the last sentence from the form of a Recommendation to a definite requirement. It reads:

Latin terminations are used so far as possible for new names.

The Zoological Rules state:

The scientific name of an animal must be a word that is either Latin or Latinised or considered and treated as such in case it is not of classic origin.

The standard of classical Latin is not to be applied in such a manner as to ignore later developments of the language or to override considerations of scientific accuracy, uniformity, intelligibility or practical usefulness.

This Principle applies to names of genera and subgenera and to specific and subspecific epithets. In general, it is clearly intended that a name taken from a language such as Greek should be transliterated in accordance with classic usage, and that the word be placed in the appropriate Latin declension with Latin endings. Each of the biological codes of nomenclature has added some rules and recommendations to supplement those of classic usage for situations not envisaged in classic Latin.

Section 1 (Chapter 3), Rules 1–9 on “Naming of Taxa of Various Ranks” and Section 7 (Chapter 3), Rules 27–28 on “Orthography and Gender of Names” with their Recommendations, together with Appendices A and B, spell out in some detail the interpretation of this Principle 4. The types of problems (with examples) encountered are discussed in the several annotations.

PRINCIPLE 5. Nomenclature deals with:

- (1) **The terms which denote the categories of taxa** (taxonomic groups or units, such as species, genus, family) and the relative ranks of these categories.
- (2) **The names which are applied to the individual taxa (taxonomic groups), such as** *Bacillus subtilis*, *Streptococcus*, *Spirillaceae*, *Spirochaetales*.

NOTE 1. The use of the word *taxon* (plural *taxa*) is appropriate for the term taxonomic group or the word group wherever used in the sense of taxonomic group in this Code. The word group has as its preferred use in bacteriology that indicated in Recommendation 8a.

NOTE 2. The word name, unless otherwise indicated, means a name which has been validly published, whether legitimate or illegitimate.

A legitimate name or epithet is one that is in accordance with the rules.

An illegitimate name or epithet is one that is contrary to the rules.

The correct name of a taxon with a particular circumscription, position, and rank is the name which must be adopted for it under the rules.

A name is effectively published when its publication is in accordance with Rule 11.

A name is validly published when its publication is in accordance with Rules 12, 13 and 14.

ANNOTATIONS

Principle 5. The Botanical Code has practically identical wording. The Zoological Code neither defines nomenclature nor notes the differentiation of terms denoting categories and names of taxa, though there is in this Code implicit recognition of the existence of distinctions.

The names and relative ranks of the several categories of taxa are given in Principle 7 (p. 13).

Note 1. The statement in the Botanical Code reads:

Taxonomic groups of any category will, in this Code, be referred to as *taxa* (singular, *taxon*).

The fourteenth International Congress of Zoology at Copenhagen, 1953, approved the introduction of the expression "taxon" to represent the concept "taxonomic unit." "The expression is to be used wherever appropriate, throughout the Zoological Code."

Note 2. The definitions of the several phrases as given in the Bacteriological Code correspond to those of the Botanical Code.

The Zoological Code does not recognize certain of the phrases of Note 2, and uses a different terminology for others, particularly the following:

An *available name* is one which is "sufficient nomenclaturally" (as contrasted with "taxonomically"). Apparently this corresponds in part to the phrase "legitimate name" of Note 2.

A *valid name* is one which is "sufficient taxonomically" (as contrasted with "nomenclaturally").

The phrase "duly published" is apparently used in much the same sense as "validly published" in the Bacteriological Code.

PRINCIPLE 6. The rules and recommendations of bacteriological nomenclature apply to all bacteria, recent and fossil, with certain distinctly specified exceptions.

ANNOTATIONS

Principle 6. The corresponding statement of the Botanical Code reads:

The rules and recommendations of botanical nomenclature apply throughout the plant kingdom, recent and fossil, with certain distinctly specified exceptions.

Note. In general the International Code of Botanical Nomenclature applies also to Bacteria. However, many special provisions are needed for this group and for this reason a special International Code of Bacteriological Nomenclature has been provided by the International Microbiological Congress. (See Jour. Gen. Microbiology 3 (3):444, 1949).

PRINCIPLE 7. The terms which denote the rank of taxonomic groups (taxa) are defined as follows:

(a) Every individual is treated as belonging to a number of categories of consecutive rank and consecutively subordinate; of these the species is the basic one. The principal categories in ascending sequence are species (species), genus (genus), family (familia), order (ordo), class (classis), division (divisio). In some genera the rank subgenus may be distinguished, and in some families the rank tribe.

(b) In many species, subspecies or varieties are distinguished; in some cases subdivisions of a species such as strains, groups, serotypes, variants, phases and others may be recognized.

(c) If a greater number of intermediate categories (ranks) are required, the terms for these subdivisions are made by adding the prefix "sub-" to the terms denoting the ranks. Thus, subfamily denotes a rank between a family and a tribe, subtribe a rank between a tribe and a genus, etc.

(d) The definition of each of these categories (ranks) varies, up to a certain point, according to individual opinion and the state of the science; but their relative order, sanctioned by custom, must not be altered. No classification is admissible which contains such alterations.

ANNOTATIONS

Principle 7. The categories of taxa that are recognized in the Bacteriological Code may be summarized as follows:

- | | |
|--|---|
| 1. (Division) (<i>Divisio</i>) | 9. (Tribe) (<i>Tribus</i>) |
| 2. (Subdivision) (<i>Subdivisio</i>) | 10. (Subtribe) (<i>Subtribus</i>) |
| 3. Class (<i>Classis</i>) | 11. Genus (<i>Genus</i>) |
| 4. (Subclass) (<i>Subclassis</i>) | 12. (Subgenus) (<i>Subgenus</i>) |
| 5. Order (<i>Ordo</i>) | 13. Species (<i>Species</i>) |
| 6. (Suborder) (<i>Subordo</i>) | 14a. (Subspecies) (<i>Subspecies</i>) |
| 7. Family (<i>Familia</i>) | 14b. (Variety) (<i>Varietas</i>) |
| 8. (Subfamily) (<i>Subfamilia</i>) | 15. Individual (<i>Individuum</i>) |

The above categories of taxa are recognized also in the Botanical Code. Certain others are recognized as admissible. One may insert between Subgenus and Species the categories Section (*Sectio*), Subsection (*Subsectio*), Series (*Series*) and Subseries (*Subseries*).

The Bacteriological Code also recognizes certain subdivisions of species (Recommendation 8a 1–6) such as Strain, Serotype, Group, Phase, *Forma Specialis*, Variant, Stage and State. These are termed infrasubspecific forms and are to be regarded as categories of taxa.

The Zoological Code has definitely recognized relatively few categories. A series of groups of categories or ranks is in process of development at the present time (1957). The group of categories from Subphylum upwards is to be called the "Phylum Group," that from Suborder to Superclass inclusive is the "Order/Class Group," between the Generic Group and the Order/Class Group is the "Family Group," followed by the "Generic/Subgeneric Group," and the "Species/Subspecies Group." The category variety is not recognized.

The complexity of the problem of subdividing species has led the zoologists to recognize "infrasubspecific" names for any "form of a species other than a subspecies." Many of the problems of nomenclature in this group of infrasubspecific forms resemble those met in bacteriology.

The hierarchy of categories of taxa has not been as definitely fixed in zoology as in bacteriology and in botany. This situation has come about in part by the development of special precedents and even separate nomenclatural codes in the past by zoological workers (as the entomologists) in large and special groups.

PRINCIPLE 8. The primary purpose of giving a name to a taxonomic group is not to indicate the characters or the history of the group, but to supply a means of referring to it.

ANNOTATIONS

Principle 8. The Botanical Code adds to this statement: "and to indicate its general taxonomic position."

In some cases names are long and cumbersome because an author conceived it his duty to include as full a description of the taxon as practicable. It is desirable, but not necessary, that names be appropriate and descriptive. A generic name such as *Deazotonitranitriazobacterium* Ambroz 1913 was an attempt to indicate the fact that bacteria of this genus are small rods capable of producing free nitrogen from nitrates and nitrites. The tendency to form descriptive epithets, if not too long, is laudable and is definitely advised (see Recommendation 6b). But if the advice is not taken, and a name (particularly a specific epithet) is given which is regarded by a subsequent author as nondescriptive or even unsuitable, such name is not to be changed for this reason; it still serves the useful purpose of supplying "a means of referring to it."

PRINCIPLE 9. Each order or taxon of lower rank with a given circumscription, position and rank can bear only one correct name, the earliest that is in accordance with this Code of Nomenclature. Provision is made for exceptions that have been approved for inclusion in the list of nomina conservanda.

In subgenera, genera, and groups of higher rank to order inclusive, the correct name is the earliest name published, provided that this is in conformity with the rules of this Code. In species the correct name is the binary and in subspecies the ternary combination of the generic name with the earliest available legitimate epithet validly published with the same rank.

ANNOTATIONS

Principle 9. This principle is the basis in the Rules for Sections 1 (Naming of Groups of Various Ranks), 3 (Publication of Names), 5 (Changes in Names as a Result of Segregation, or Union of Taxa or Changes in Rank of Taxa) and 6 (Rejection and Replacement of Names).

PRINCIPLE 10. Bacteriologists are urged not to change the name of a taxon without serious motives, based either on more profound knowledge of facts or on the necessity of giving up a nomenclature that is contrary to the Rules of this Code.

ANNOTATIONS

Principle 10. The corresponding Article 17 of the Botanical Code (Seventh Botanical Congress, Stockholm, 1952) was included as a Rule with a Recommendation which read:

Art. 17. No one may change a name (or combination of names) without serious motives, based either on more profound knowledge of facts or on the necessity of giving up a nomenclature that is contrary to the rules of this Code.

Recommendation 17A. Changes in nomenclature should be made only after adequate taxonomic study.

The Nomenclature Section of the eighth International Botanical Congress (Paris, 1954) agreed that the above Article 17 should not be included in the rules but transferred to Chapter I, Art. 2, under "General Considerations, Guiding Principles and Definitions", and that consideration should be given by the Editorial Committee to the following substitute wording:

No one can change a name (or a combination of names) without serious motives based either on some adequate taxonomic study or on the necessity of giving up a nomenclature that is contrary to the rules of this Code.

One may conclude that the phrase "based on more profound knowledge of facts" may well be interpreted to mean "based upon some adequate taxonomic study."

The Zoological Code does not directly rule on the above problem.

Principle 11.

PRINCIPLE 11. The application of the names of taxonomic groups (taxa) is determined by means of nomenclatural types. A nomenclatural type is that constituent element of a taxon to which the name of the taxon is permanently attached.

NOTE. The nomenclatural type is not necessarily the most typical or representative element of a taxon. It is merely that element with which the name of a taxon is permanently associated.

ANNOTATIONS

Principle 11. The meaning and significance of this principle defining the phrase *nomenclatural type* are developed by Rule 9 (p. 53). For example, the species *Bacillus subtilis* has been designated as the nomenclatural type of the genus *Bacillus*. Whenever a genus *Bacillus* is recognized by an author, he must include within it the species *Bacillus subtilis*. One might even define the genus *Bacillus* as consisting of the type species, *Bacillus subtilis*, together with such other species as are placed with it because presumably sufficiently closely related (congeneric).

The corresponding statement in the Botanical Code of 1952 (Article 18) is essentially the same, with the exception of the second sentence, which reads:

A nomenclatural type (*typus*) is the constituent element of a taxon to which the name of the taxon is permanently attached, whether as an accepted name or as a synonym.

The type concept is outlined in Articles 18, 19, 21 and 22.

The Zoological Code outlines the type concept in much greater detail than does either the Bacteriological or Botanical Code.

PRINCIPLE 12. A name of a taxonomic group has no status under the Rules and no claim to recognition by bacteriologists unless it is validly published.

ANNOTATIONS

Principle 12. Section 3 of the Bacteriological Code, Rules 10-14 (pp. 59-71) outline the requirements for valid publication.

The Botanical Code gives essentially the same Rules and Recommendations in its Articles 39-54, but in greater detail. The differences between the codes will be noted in the Annotations on pp. 59-71.

The Zoological Code likewise has a long list of Rules and Recommendations relative to publication which are noted also in the Annotations.

CHAPTER 3

Rules of Nomenclature
With
Recommendations

Rules of Nomenclature With Recommendations

Section 1

Naming of Taxonomic Groups (Taxa) of Various Ranks

RULE 1. The names of all taxonomic groups (taxa) above the rank of genus are substantives or adjectives used as substantives, of Greek or Latin origin, or Latinized words, in the plural number.

ANNOTATIONS

Rule 1. Basically the names of all taxa from genus to order inclusive are plural adjectives modifying the word *plantae*. They are now recognized and treated as nouns. Rule 4 designates special endings that are to be used as suffixes in the formation of names of these higher taxa. The plural adjectival endings in general have the meaning of "like" or "resembling."

RULE 2. Names of all taxonomic groups (taxa) above the rank of family are taken preferably from a combination of characters covering the nature of the taxa as closely as possible, or from a single character of outstanding importance.

RECOMMENDATION 2a. Names of new orders and suborders should preferably be based upon the name of the type genus of a contained family.

ANNOTATIONS

Rule 2. The corresponding Article (16) in the Botanical Code reads:

The principles of priority and typification do not apply to names of taxa above the rank of order.

Recommendation 16a of the Botanical Code suggests that certain endings for taxa above the rank of order be used. It states:

(a) The name of a division is preferably taken from characters indicating the nature of the division as closely as possible; it should end in *-phyta*, except when it is a division of *Fungi*, in which case it should end in *-mycota*. Words of Greek origin are generally preferable.

The name of a subdivision is formed in a similar manner; it is distinguished from a divisional name by an appropriate prefix or suffix or by the ending *-phytina*, except when it is a subdivision of *Fungi*, in which case it should end in *-mycotina*.

(b) The name of a class or of a subclass is formed in a similar manner, and should end as follows:

1. In the *Algae*: *-phyceae* (classes) and *-phycidae* (subclasses);
2. In the *Fungi*: *-mycetes* (classes) and *-mycetidae* (subclasses);
3. In the *Cormophyta*: *-opsida* (class) and *-idae* (subclasses).

In bacteriology little or no use is made of names of taxa above that of class.

RULE 3. Names of taxonomic groups (taxa) between suborder and genus are formed by the addition of the appropriate suffix to the stem of the name of the type genus.

ANNOTATIONS

Rule 3. The Bacteriological and Zoological Codes have equivalent statements. The Botanical Code has no over-all formulation but states the case for families as follows:

The name of a family is a plural adjective used as a substantive formed by adding the suffix *-aceae* to the stem of the name of its type genus or of a synonym of this name, even if illegitimate.

The Zoological Rules state:

When the name of the type genus (or its terminal portion) is a word of Greek or Latin origin, its genitive termination is to be replaced by the appropriate Family-Group termination (e.g. "*-idae*" for family, "*-inae*" for subfamily). If incorrectly formed when first published, such a group name is to be automatically corrected. A Schedule to the Rules is to illustrate the correct method of forming such names.

Where the name of the type genus is not of Greek or Latin origin, or is an arbitrary combination of letters, the name first published for that Family-Group unit with the appropriate termination is to be accepted.

An author, when forming a Family-Group name based on a word not of Greek or Latin origin, should select such portion of the name of the type genus as, with the appropriate termination, will reveal the relation between the generic name and that of the Family-Group unit, and will give the name so formed the simplest and most euphonious form compatible with that relationship.

The Bacteriological and Botanical Codes agree that the appropriate suffix of the taxonomic rank is to be added to the stem of the name of the type genus (or, in botany, alternatively to the name of a synonym of the type genus).

The Zoological Code directs that the suffix is to replace the genitive ending of the name of the type genus. Statements of the Zoological and Bacteriological Codes are intended to be equivalent.

It will be noted that the Zoological Code is to provide a Schedule to be appended to the Rules to illustrate what changes are to be made in the name of the type genus before adding the suffix indicating the rank of the new taxon.

Such a Schedule was proposed for the Botanical Code by Ponce de Léon and Alvarez (Taxon 3:45, 1954) but was rejected.

Determination of the spelling of stems or combining forms to be used with appropriate suffixes is primarily a problem of orthography, and the discussion is delayed to the annotations of Section 7 on Orthography and Gender of Names (Rule 27, p. 99ff.), *q.v.*

RULE 4. Names of taxonomic groups between subclass and genus have suffixes to fix the taxonomic rank. The suffix for orders is *-ales*, for suborders *-ineae*, for families *-aceae*, for subfamilies *-oideae*, for tribes *-eae* and for subtribes *-inae*.

ANNOTATIONS

Rule 4. The suffixes specified in the Bacteriological Code for formation of names of higher taxa between subclass and genus and those authorized by the Botanical Code are identical. The Zoological Code specifies two suffixes only: all family names must end in *-idae* and subfamily names in *-inae*. No endings to be used for other higher taxa have been officially recognized.

The suffixes used in both Bacteriological and Botanical Codes are all plural feminine adjective endings. The singular forms of these suffixes are *-alis*, *-inea*, *-oidea*, *-ea* and *-ina*. The suffix *oidea* is derived from the Greek, *-ina* may be either a Greek or a Latin suffix, the others are Latin adjectival suffixes. All as here used have the connotation of "like" or "resembling" or "having the characteristics of." These endings are in the feminine plural as they in theory modify the plural Latin noun *Plantae*. The family name *Spirillaceae* literally has the meaning of "spirillaceous plants," that is, plants (organisms) resembling those of the genus *Spirillum*. However, in modern nomenclature the names of taxa above genus are treated as plural substantives (nouns) and not as adjectives. Further discussion of the formation of names of higher taxa will be found in the annotations in Section 7 under "Orthography and Gender of Names" (p. 99ff.).

Occasionally (rarely) one finds the name of one of the higher taxa used in the singular. One may, for example, designate an organism as a *Spirillacea* meaning that it is one of the species belonging to the family *Spirillaceae*. This is done not infrequently in Botany; the phrases "this is a *Rosacea*" or "a new *Rosacea*" are briefer than "this belongs to the *Rosaceae*" or "a new species of *Rosaceae*." Apparently this usage has been confined almost entirely to the singular of family names; however, such use of a family name in the singular is rare in microbiology.

Authors sometimes change the spelling of names of higher taxa to conform to the characteristic of the vernacular in which they write. In French the family name *Spirillaceae* may change from its Latin form to *Spirillacées* and in German to *Spirillaceen* (or more frequently to *Spirillazeen*). Trevisan used as a title for an important taxonomic brochure "I generi e le specie delle Batteriacee." Billet used the phrase "d'une nouvelle bacteriacée marine." This is not

customary in English; one does not often find a usage such as spirillaceas. Such words with the modified spellings are no longer Latin, they are vernacular, and are not the names authorized by the international agreements of the several codes of nomenclature. They may be justified in non-scientific writing but cause difficulty when, as has happened, new names of higher taxa such as families are proposed in the vernacular spelling. Does such a word have standing in nomenclature when not spelled as a Latin word? Should such words be discarded as not validly published and replaced, or should the incorrect spellings be regarded as unintentional error and corrected? No formal Opinion has been rendered. It may be that the legitimacy of such vernacular names of higher taxa should be considered individually.

RULE 5a. Names of genera and subgenera are substantives (or adjectives used as substantives) in the singular number and written with an initial capital. The names may be taken from any source whatever and may even be composed in an arbitrary manner. They are treated as Latin substantives.

RULE 5b. Generic names and subgeneric names are subject to the same rules and recommendations, and from a nomenclatural standpoint they are co-ordinate.

RULE 5c. If a genus is divided into subgenera, one of the subgenera (that which includes the type species of the genus) must bear the same name as the genus.

NOTE. Citations of authors are governed by Rule 16.

ANNOTATIONS

Rule 5. Genera and subgenera. Rule 5a is much like that of the Botanical Code.

Rule 5 is similar in intent to several articles in the Zoological Rules, which provide that:

1. A generic name must consist of a single word, simple or compound, written with a capital initial letter, and employed as a substantive in the nominative singular.
2. Generic and subgeneric names are subject to the same rules and recommendations, and from a nomenclatural standpoint, they are co-ordinate, that is, they are of the same value.
3. A generic name becomes a subgeneric name when the genus so named becomes a subgenus, and vice versa.
4. If a genus is divided into subgenera, the name of the typical subgenus must be the same as the name of the genus.

Rule 5 makes it clear that if a genus is found to contain two or more readily differentiable groups of species, each group may be recognized as a subgenus. One of the subgenera, that which includes the type species, must have the same name as that of the genus. If it is desired to recognize each of the groups of species as a distinct genus, the subgeneric names then become generic names.

Conversely, when two or more genera are united, the names of the genera become the names of subgenera if subgenera are recognized.

The Paris (1954) revision of the Botanical Code has modified the treatment of taxa between genus and species. The pertinent Article (21) reads in part:

The name of a subdivision of a genus is a combination of a generic name and a subdivisional epithet connected by a term (subgenus, section, series, etc.) denoting its rank.

The epithet of a subgenus or section must not be formed from the name of the genus to which it belongs by adding the ending *-oides* or *-opsis*.

The Botanical Recommendation 21A reads:

For a subgenus and a section the epithet is usually a substantive resembling the name of a genus or repeating the name of the genus itself.

For a subsection and a lower subdivision of a genus the epithet is preferably a plural adjective agreeing in gender with the generic name and written with a capital initial letter.

The treatments of subdivisions of a genus are distinctly different in Botany and in Bacteriology. These differences may be summarized:

1. Bacteriology recognizes the subgenus as the only subdivision between genus and species. Botany recognizes several, including subgenus, section, subsection, series and subseries.
2. Bacteriology and Zoology regard a subgeneric name as subject to the same rules and recommendations as a generic name. Botany has a series of special rules: the subgenus and genus are *not* co-ordinate nomenclaturally.
3. Bacteriology agrees with Zoology in regarding names of all subgenera, genera and higher groups as uninomial. Botany regards the name of a subgenus as an epithet related to or modifying the generic name.
4. Bacteriology and Zoology definitely regard the subgenus as a taxon. Whether the subgenus in Botany is a taxon is problematical. It is difficult to equate *epithet* and *taxon*.
5. Bacteriological and zoological rules forbid the use of the same subgeneric name in different genera. The name of a subgenus may be the same as that of the genus in which it is included, but may not be a homonym of the name of another genus. In Botany the subgeneric epithet in a genus may duplicate the name of another genus or of an epithet of a subgenus in another genus.

Names of Genera. Although Rule 5 states that almost any combination of letters may be proposed and used as a generic name; authors should hold in mind the directive of Principle 4 which states that names of taxa are usually taken from Latin or Greek, but if taken from any other language or formed in an arbitrary manner they are to be treated as Latin, and Latin terminations should be used so far as possible. In other words, while any combination of letters may be used, certain methods of coining generic names are much to be preferred. One may well observe the Linnaean injunction that the most appropriate and satisfactory generic name is one derived from the Greek, usually the result of joining appropriate Greek stems to form a new word.

Examples of generic names,

With a single Greek stem: *Bacterium*, *Clostridium*, *Proteus*, *Plectridium*.

Compounds with two Greek stems: *Actinomyces*, *Aerobacter*, *Chondromyces*, *Corynebacterium*, *Streptococcus*, *Haemophilus*, *Treponeuma*, *Thiothrix*, *Pseudomonas*.

With a single Latin stem: *Vibrio*, *Spirillum*, *Sarcina*, *Bacillus*, *Cloaca*.

Compounds with two Latin stems: *Putribacillus*, *Lactobacillus*, *Fusiformis*.

Latinized names of persons: *Borrelia*, *Kurthia*, *Gaffkya*, *Escherichia*, *Erwinia*, *Gallionella*, *Pasteurella*, *Klebsiella*, *Eberthella*.

Latin-Greek hybrid names: *Brevibacterium*, *Flavobacterium*, *Actinobacillus*, *Acetobacter*, *Acetomonas*.

Names of Subgenera. Names of subgenera, as noted, are formed exactly as are the names of genera. When included in the name of a species, the subgeneric name is placed in parentheses between the name of the genus and the specific epithet. If one recognizes two subgenera in the genus *Bacillus*, one (that including the type species of the genus) must bear the same name as the genus. One would then write *Bacillus* (*Bacillus*) *subtilis* and *Bacillus* (*Aerobacillus*) *polymyxa* to designate species of two subgenera differentiated on the basis of gas production. The name of a subgenus is not combined with a specific epithet independently of the generic name; the use of *Aerobacillus polymyxa* indicates recognition of *Aerobacillus* as a generic name. The requirement that one subgenus in a genus must bear the same name as the genus (Bacteriological Code 1947) would make necessary the revision of Pederson's (1945) recognition in the genus *Lactobacillus* of three subgenera: *Thermobacterium*, *Streptobacterium* and *Betabacterium*; the one containing the type species should be called *Lactobacillus*.

Use of the generic name. The commonest use of a generic name is in combination with a specific epithet to form a binary combination (the scientific name of a species). The generic name *Bacillus* with the specific epithet *subtilis* gives *Bacillus subtilis*. But the generic name is also commonly used without designation of species. There is some confusion in the literature of bacteriology and some evidence of differences of opinion as to such independent use of a generic name. The generic name singly is often used in the sense of "this species of" the genus, or even "this individual" or "this strain" of a species. Custom throughout biology has apparently approved this usage. One may, therefore, write appropriately "this *Salmonella*." The context determines whether reference is to a particular species of the genus or to an individual strain of a species. The generic name is frequently used when it is desired to avoid allocating an isolate to a particular species; the statement, "This *Salmonella* was isolated from an egg," merely places the strain in the appropriate genus.

There is some difference of opinion as to the use of a generic name in the plural. The Bacteriological Code, as well as others, states that there can be only one correct name for a genus, and that no other genus can legitimately have the same name. It has been urged that inasmuch as there can be but one genus correctly named *Salmonella*, the use of the plural *Salmonellae* would imply the existence of more than one genus *Salmonella*, which, under the rules, is

not allowable; the use of the plural, it is contended, is therefore inadmissible. However, the plurals of generic names have been, and are being, used by nomenclators. Such use has been commonly accepted. The argument for such use may be phrased as follows. Each species has a name made up of two words, the name of the genus followed by a specific epithet. If it is permissible to write "this *Salmonella*" meaning a representative of a species of the genus *Salmonella*, similarly it should be permissible to write *Salmonellae* for two or more species or strains belonging in the genus *Salmonella*. This use is well established with the meaning "species of" or "example of" or "members of" the genus *Salmonella*.

Sometimes a generic name in the singular form is used incorrectly with a plural meaning; for example, in the statement "*Salmonella* are abundant in sewage." The argument for this usage is that there are many species of *Salmonella*, hence this generic name may be regarded as a collective noun, as the word "committee" in English, and hence may be used either in a plural or singular sense. The argument is questionable. There is no warrant for the use of the singular form of a generic name in the sense of "the several species of the genus *Salmonella*" or "strains of the genus *Salmonella*."

Is it advisable that generic names be accepted in modern languages and the spelling and usage be made to conform to the vernacular?

Two recommendations of the Botanical Code are pertinent:

When writing in modern languages botanists should use Latin scientific names or those immediately derived from them in preference to names of another kind or origin (popular names). They should avoid the use of the latter unless these are very clear and in common use.

Every friend of science should oppose the introduction into a modern language of names of plants which are not already there, unless they are derived from Latin botanical names by means of some slight alteration.

When a generic name is used repeatedly in general or nontaxonomic publications, custom has permitted, in fact, encouraged, the use of the vernacular version of the name. In English the use of the same spelling is usually advisable, but without capitalization and without italicizing. One has the choice of use of the vernacular or the Latin plural endings. The latter are often preferable to avoid unsatisfactory use of plurals ending in -s when the Latin name ends in -s. Certainly "lactobacilli" is a preferred spelling, but one may use "salmonellas" or "salmonellae."

Orthography of generic names. Annotations relative to formation of generic names will be found under Section 7 (Orthography and Gender of Names, Rule 27) and in the several appendices.

RECOMMENDATION 5a. Bacteriologists who are forming new generic or subgeneric names should attend to the following recommendations:

- (1) Not to make names very long or difficult to pronounce.
- (2) To make names that have an agreeable form readily adaptable to the Latin tongue.
- (3) Not to dedicate genera to persons quite unconnected with bacteriology or at least with natural science or to persons quite unknown.
- (4) To avoid the use of adjectives as nouns.
- (5) Not to make names by combining words from different languages (*nomina hybrida*).
- (6) To give a feminine form to all personal generic names, whether they commemorate a man or a woman.

ANNOTATIONS

Recommendation 5a (1). Clements (1902) suggested that generic names should not be longer than six syllables. There are a few that are longer; but none of these has proved troublesome. Among the latter are *Corynebacterium* and *Propionibacterium*.

Some very long generic names have been proposed in the past, but such proposals usually have been defective in publication, and it has not been necessary to consider their legitimacy.

One reason for recommending the choice of relatively short generic names is that from them may be formed the names of higher taxa (as families, etc.) by the addition of appropriate suffixes, increasing their length by one, two or even three syllables. The family name derived from *Actinomyces* (5 syllables) is *Actinomycetaceae* (8 syllables). A family name based upon *Propionibacterium* would have ten syllables (*Propionibacteriaceae*).

The Zoological Code recommends that new generic and subgeneric names should be short and "from the Latin standpoint, euphonious."

A Zoological Recommendation lists twelve classes of words that may be used as generic names:

- 1) Greek substantives transliterated by the Latin rules.
- 2) Compound Greek words.
- 3) Latin substantives.
- 4) Compound Latin words.
- 5) Greek or Latin derivatives expressing comparison, diminution, possession or resemblance.
- 6) Mythological or heroic names (with Latin termination).
- 7) Proper names used by the ancients.
- 8) Modern surnames with a suffix denoting dedication.
- 9) Names of ships treated either like mythological names or as modern surnames.
- 10) Words of non-classic origin.
- 11) Words formed by an arbitrary combination of letters.
- 12) Names formed by anagram.

Recommendation 5a (2). Many names considered difficult because not readily adapted to the Latin come from words transliterated

from languages employing an alphabet other than Latin. Such, for example, are the Arabic and Slavic languages.

Recommendation 5a (3). In general bacteriologists have adhered to the recommendation not to make inappropriate dedications. There are very few generic names of bacteria derived from the names of persons who were not concerned with microbiology.

Recommendation 5a (4). This recommendation, not to use adjectives as generic names, has been ignored in a few instances. For example, Castellani and Chalmers placed *Bacillus faecalis alcaligenes* Petruschky 1896 in a new genus which they named *Alcaligenes* ("alkali-producing"). When used as a generic name it is treated as a substantive ("that which forms alkali"). Among names proposed for genera and having an adjectival form are *Encapsulatus* Castellani and Chalmers, *Dysenteroides* Castellani and Chalmers, *Fusiformis* Hoelling and *Albofaciens* Castellani and Chalmers.

Recommendation 5a (5). Generic names formed by combining stems from different languages are common in microbiology, particularly names which combine stems from Latin and Greek. This recommendation is one of the oldest in biological nomenclature. Linnaeus voiced disapproval of *nomina hybrida*. But violations of the spirit of the recommendation are numerous and continuing. There are many reasons for apparent disregard for this recommendation.

For example, an author in search of a name for a new genus may wish to indicate that his organism has some of the characters of the genus *Bacillus* but is not a true *Bacillus*. He coins the new generic name *Pseudobacillus*, a false *Bacillus*. But the name is a hybrid and hence undesirable; the first stem *pseud-* is Greek and *bacillus* is Latin. The author could have chosen the Latin word *falsus* also meaning false and could have coined *Falsibacillus* in which both component stems are Latin. The Latins themselves occasionally used *fals-* as the first component of a compound word. Even more frequently a Latin prefix is the first component of a compound in which the second is Greek. An author wishes to publish a generic name with the meaning "short rod." He knows that the Greek word *bacterium* means rodlet. The Latin word for short is *brevis*, the Greek is *brachys*. He chooses *Brevibacterium* and sponsors a Latin-Greek compound rather than the etymologically more correct *Brachybacterium*. It has been argued, and perhaps with justification, that a Greek word such as *bacterium*, when it becomes a generic name (*Bacterium*), is under the rules of all codes to be treated as Latin (see Principle 4 of this Code.) If the generic name is to be regarded and treated as Latin, why should not Latin prefixes be used? With

this interpretation, *Brevibacterium* would not mean the "short rodlet" but the "short *Bacterium*."

However, hybrid generic names, if validly published, have the same status as though they were correctly formed.

The Zoological Rules recommend that a Greek word should not be combined with a Latin word in forming a generic name.

Recommendation 5a (6). In Latin the names of most plants (not all) are feminine. Obviously, if all generic names in botany or bacteriology were feminine some problems of nomenclature would be simplified. Later it will be noted that it is recommended that generic names formed from the names of persons, whether men or women, should end in *-a* or *-ia* and be treated as feminine nouns.

This recommendation has not always been followed; there have been proposed as bacterial generic names such derivatives as *Wesenbergus* Castellani and Chalmers, and *Macintoshillus* Heller.

The Zoological Code does not recommend that personal names be Latinized into feminine generic names, but suggests the use of endings which are masculine, feminine or neuter. In practice, however, zoologists have usually preferred to put generic names derived from patronymics in feminine form.

The Botanical Code includes several additional recommendations of interest, namely:

- (a) To use Latin terminations insofar as possible.
- (c) To indicate, if possible, by the formation of ending of the name the affinities or analogies of the genus.
- (g) Not to use a name similar to or derived from the epithet of one of the species of the taxon.

RULE 6. The name of a species is a binary combination consisting of the name of the genus followed by a single specific epithet. If an epithet consists of two or more words, these must either be united or hyphenated.

NOTE. A specific epithet consisting of two or more words not joined by hyphens when originally published is not to be rejected, but when used the words are to be hyphenated or joined.

Specific epithets are:

- (1) Adjectives, which must agree grammatically with the generic name.
- (2) Substantives, in the nominative, in apposition with the generic name.
- (3) Substantives in the genitive.

A specific epithet may be taken from any source whatever and may even be composed arbitrarily. Within the same genus, no two species names may bear one specific epithet.

NOTE. The term "epithet" as used here implies a single descriptive word or a single descriptive phrase consisting of two or more words. If the author of the name of a species proposed an epithet consisting of two or more words, but without hyphenating or joining, the form is to be corrected, but without prejudice.

ANNOTATIONS

Rule 6. The first two sentences of this rule agree with the statement of the Botanical Code. The word "combination" as here used is defined in the Botanical Code: "The name of a taxon below the rank of genus, consisting of the name of a genus combined with one or more epithets, is termed a combination." The statement relative to the kinds of specific epithets agrees also with that of the Zoological Code. The latter, however, includes in the rule directives as to the formation of specific epithets indicating dedication to one or more persons (see Rule 27).

Discussion of formation of specific epithets from names of persons is to be found in Chapter 3, Sec. 7, Rule 27 and its Recommendations.

The name of a species. The rule is clear. The name of a species is a binary combination of the name of the genus followed by a specific epithet. The specific epithet is not the *name* of the species; it should not be used singly to designate a species.

The Zoological Code emphasizes this point:

The scientific designation of animals is uninominal for subgenera and all higher groups, binominal for species, and trinominal for subspecies.

There is, however, confusion in biological literature due to lack of agreement among those concerned with taxonomy and nomen-

clature as to the appropriate designation of the second component of the species name, as well as to the designation of the name of a species. In bacteriology and botany this second component is termed the *specific epithet*. The directive under the Zoological Rule is quite different. The Paris Zoological Congress (1948) agreed that the "term 'specific name' should be reserved to denote the binominal combination which constitutes the scientific name of a species." This statement conforms to usage in bacteriology and botany. It was also agreed at Paris that the

expression "trivial name" (based on early Linnaean usage) should be adopted to denote the second part of the binominal combination, *i.e.* the term which is used within a given genus to distinguish any given species from every other species (or subspecies) referred on taxonomic grounds to that genus.

This made the term "trivial name" a synonym of "specific epithet" as used in bacteriology and botany. A radical change was directed at the Copenhagen (1953) Zoological Congress which approved the recommendation of the "Colloquium" that the expression "binomen" be introduced, "defining that expression as denoting the binominal combination which constitutes the scientific name of a species." In other words, "binomen" was substituted for the previously approved "specific name." The Copenhagen Congress further decided that the "reversion to the use of the expression 'trivial name' was misconceived." It repealed the Paris decision and substituted the expression "specific name" for "trivial name" on the basis that the former expression had been released by the approval of the expression "binomen" for the name of a species as noted above. This action means that in zoology "*specific name*" equates with "*specific epithet*" in bacteriology and botany, and the zoological term "*binomen*" equates with "*specific name*" or "*species name*" in other biological sciences.

The use of an identical expression "specific name" for two distinct concepts, the one in zoology and the other in bacteriology and botany, is unfortunate. Perhaps the difficulty lies in the zoological use of the word "name." In the expression "trivial name" and the later emendation "specific name" the word "name" is not intended to designate a taxon.

The term specific epithet. This term, as used in bacteriology and botany, requires examination and definition. The specific epithet is the second component of the name of a species. Most often it is a single word, but it may consist of two (or even more) words providing these words are together required to express a single concept or description. A species name that has two or more *unrelated* words

used as epithets is illegitimate; it is not a binary combination. The species name having a single epithet made up of two or more words as contrasted with a species name in which appear two or more epithets may be illustrated. An organism belonging to the genus *Streptococcus* that lives in sour milk is to be named. The two words, sour milk, taken together name a single concept; together they constitute a single epithet. From *lac*, *lactis* (milk) and *acidum* (sour) is derived an appropriate specific epithet, and the organism is named *Streptococcus lactis-acidi*. The *Streptococcus* of lactic acid may be termed *Streptococcus acidi-lactici* (from *acidum lacticum* = lactic acid). A common source of compound specific epithets in bacteriology is formation from the names of diseases with which the organisms may be associated. For the organism producing haemorrhagic septicemia, Sternberg proposed the name *Bacillus septicaemiae-haemorrhagicae*. This name has a single specific epithet and does not contravene the directive of Rule 6 that a name of a species must be a binary combination with only a single specific epithet. Pfeiler isolated from the gangrenous udder of a sheep a coccus which he named *Micrococcus mastitidis-gangraenosae-ovis*, the *Micrococcus* of gangrenous mastitis of sheep. Again, this is a single specific epithet, it is the Latinized name of a disease, and the species name accords with the rule.

The fact that a long compound specific epithet is acceptable in the sense that it does not contravene a Rule does not mean that it is desirable. Recommendation 6b (2) advises that specific epithets should not be long. Long names are cumbersome. As a result of a request from a group of bacteriologists working with microorganisms associated with mastitis in cows, the shortened name *Streptococcus agalactiae* Lehmann and Neumann was conserved against the older, correctly formed binomial *Streptococcus agalactiae-contagiosae* Kitt.

A correct species name can have but *one* specific epithet; if more than one is given the species name is illegitimate and unacceptable. There may be confusion of three groups of species names:

- (1) *Legitimate species names* in which the specific epithet is made up of two or more words. In this case the two or more words express a single idea and together modify the generic name. Example: *Pasteurella cholerae-gallinarum*, the *Pasteurella* of cholera of fowls.
- (2) *Illegitimate species names* in which there are two or more specific epithets, the several epithets not related and separately modifying the generic name. Example: *Bacillus albus lactis*, the white *Bacillus* of milk. This cannot be made legitimate by hyphenation of the two epithets to read *Bacillus*

albus-lactis, there are still two unrelated concepts. An attempt to change the illegitimate trinomial to a legitimate binomial yielded *Bacillus albolactis*. The name is a binomial but now means the *Bacillus* of white milk, not the white *Bacillus* of milk.

- (3) *Legitimate subspecies names* in which the generic name is followed by a single specific epithet and this, in turn, by a subspecific epithet, the whole ternary combination representing the name of a subspecies. This type of name will be considered under Rule 7.

Hyphenation of compound specific epithets. Rule 6 states that specific epithets made up of two or more words should either be hyphenated or the words should be united. The Rule does not indicate which choice should be made. Precedent indicates that when each component is separately declined, use of the hyphen is advised. For example, if each component is in the genitive, as in *Clostridium oedematis-maligni*, the hyphen indicates that the specific epithet is made up of two separate words, the genitive of *oedema malignum*, the name of the disease. Similarly one may write *Streptococcus lactis-acidi*. Frequently one component modifies the other, as an adjective preceding or following a noun, or is used in an adverbial sense preceding a participle or an adjective, in such cases the two components should be united into a single word, as *nigromaculatus* black-spotted, *thermophilus* heat-loving, *lentiputrescens* slowly putrefying, *albogilvus* whitish yellow. See Rule 27 and its Recommendations relating to orthography.

Kinds of specific epithets. Rule 6 states that specific epithets may be (1) adjectives, (2) nouns in apposition or (3) nouns in the genitive.

(1) *Adjectives as specific epithets.* Specific epithets may be adjectives, either simple or compound. They are of many origins, as shown *infra*:

A simple Latin adjective: *Staphylococcus aureus* the golden *Staphylococcus*; *Synangium sessile* the stalkless or sessile *Synangium*; *Neisseria sicca* the dry *Neisseria*; *Clostridium botulinum* the *Clostridium* related to sausage.

A compound Latin adjective: *Streptomyces alboflavus* the whitish yellow *Streptomyces*; *Bacillus flavoviridis* the yellowish green *Bacillus*; *Rhabdomonas fusiformis* the spindle-shaped *Rhabdomonas*.

A simple Greek adjective (transliterated into Latin and with Latin endings) *Bacillus achrous* the uncolored *Bacillus*; *Bac-*

terium chryseum the golden *Bacterium*; *Micromonospora chalcea* the bronze *Micromonospora*.

A compound Greek adjective: *Treponema calligyrum* the beautifully bent *Treponema*; *Streptomyces phaeochromogenes* the gray-color-producing *Streptomyces*; *Pseudomonas cyanogenes* the dark-blue-producing *Pseudomonas*.

An adjective formed from a place name: *Brucella melitensis* the Maltese *Brucella*; *Vibrio berolinensis* the Berlin *Vibrio*; *Actinomyces californicus* the Californian *Actinomyces*.

An adjective formed from the name of a person: *Clostridium pasteurianum* the Pasteur *Clostridium*; *Zoogloea beigeliana* the Beigel *Zoogloea*.

A participial adjective formed from a present participle: *Erwinia citrimaculans* the orange-spotting *Erwinia*; *Bacteroides coagulans* the clotting *Bacteroides*.

A participial adjective formed from a past participle: *Nocardia maculata* the spotted *Nocardia*; *Clostridium malenominatum* the badly-named *Clostridium*.

(2) *Substantives as specific epithets in apposition.* A substantive (noun) in the nominative case, in apposition with the generic name, may be used as a specific epithet. This type of modifier is found in most modern languages, as *Victoria regina*; *London the novelist*; *Burns the poet*. In general the epithet expresses some characteristic of the generic name with which it is in apposition; it has an adjectival connotation. Examples: *Bacillus radicolica*, *Bacillus* the root dweller; *Pseudomonas conjac* the conjac *Pseudomonas*; *Vibrio comma* the comma *Vibrio*.

Some specific epithets taken from languages foreign to Latin are of such form or spelling that they are not adaptable to Latin declensions. Some words of this type were assimilated into Latin and treated as undeclinable. For example, there are hundreds of personal and place names in the Latin Vulgate translation of the Bible. The use of such undeclinable nouns as specific epithets is not in accord with Principle 4, which advises that as far as possible such names be given appropriate Latin endings. In several genera of bacteria, as in the genus *Salmonella*, it has become the custom to use the name of the city or locality where the organism was first found as a specific or subspecific epithet. There are hundreds of names such as *Salmonella london*, *S. lexington*, *S. tennessee* in the literature. For the most part these organisms are differentiated on the basis of their antigenic structure; they are infrasubspecific forms (serotypes).

The Enterobacteriaceae Subcommittee of the International Committee on Bacteriological Nomenclature is actively at work on the problems of taxonomy of these organisms. It seems probable that there will finally be recognized a relatively small number of species, most with many serotypes.

(3) *Substantives in the genitive as specific epithets.* The specific epithet is often a noun in the genitive modifying the generic name. It may be one of several kinds.

Genitive singular of a personal name: *Borrelia kochii* Koch's *Borrelia*. If dedicated to more than one person of the same name, the specific epithet may be in the plural. There are several such instances in botany, but none has so far been discovered in bacteriology.

Genitive singular of the name of a locality: *Streptomyces novae-caesareae* the *Streptomyces* of Nova Caesarea (New Jersey); *Marmor angliae* the *Marmor* of Anglia (England).

Genitive of the name of a host, either plant or animal:

Genitive of the name of the genus of the plant host: *Xanthomonas antirrhini* the *Xanthomonas* of *Antirrhinum*; *Pseudomonas polygoni* the *Pseudomonas* of *Polygonum*; *Erwinia lathyri* the *Erwinia* of *Lathyrus*; *Rhizobium phaseoli* the *Rhizobium* of *Phaseolus*.

Genitive of names of plant taxa in the plural: *Rhizobium leguminosarum* the *Rhizobium* of the *Leguminosae*; *Marmor cruciferarum* the *Marmor* of the *Cruciferae*; *Xanthomonas malvacearum* the *Xanthomonas* of the *Malvaceae*.

Genitives of names of animals, singular: *Corynebacterium bovis* the *Corynebacterium* of the ox; *Haemobartonella canis* the *Haemobartonella* of the dog; *Nocardia caprae* the *Nocardia* of the goat.

Genitives of the names of animals, plural: *Arthromitus batrachorum* the *Arthromitus* of frogs.

Genitives of names of diseases or lesions: *Salmonella cholerae-suis* the *Salmonella* of cholera of the hog.

Genitives of other objects: *Streptococcus cremoris* the *Streptococcus* of cream; *Lactobacillus casei* the *Lactobacillus* of cheese; *Pediococcus cerevisiae* the *Pediococcus* of beer.

Illegitimate vernacular genitives. In a few cases illegitimate vernacular specific epithets have been introduced and have persisted for

a time in the literature. For example, Duclaux (1882) described an organism which he found associated with the production of slimy or ropy milk. He placed it in his newly named genus *Actinobacter* but did not give it a specific epithet. In consequence, the organism has been termed *Actinobacter* du lait visqueux Duclaux, an illegitimate combination.

RECOMMENDATION 6a. When it is desired to indicate the name of a subgenus in connection with the name of a species, the name of the subgenus may be placed in parentheses between the two.

ANNOTATION

Recommendation 6a. This recommendation is essentially that of the Botanical Code and agrees with the corresponding rule in the Zoological Code. The Bacteriological Code (like the Zoological) recognizes the subgenus as the single category between genus and species; the Botanical Code recognizes several intermediate categories, for example, subgenus, section, subsection, etc. The corresponding Recommendation of the Botanical Code states:

When it is desired to indicate the name of a subgenus or section (or other subdivision to which a particular species belongs) in connection with the generic name and specific epithet, the name of the subdivision is placed in parentheses between the two (when necessary, the rank of the subdivision is also indicated).

Examples: *Lactobacillus (Thermobacterium) caucasicus*; *Rickettsia (Rickettsia) prowazekii*; *Rickettsia (Dermacentroxenus) rickettsii*.

RECOMMENDATION 6b. In forming specific epithets bacteriologists should attend to the following recommendations:

- (1) To choose a specific epithet which, in general, gives some indication of the appearance, the characters, the origin, the history, or the properties of the species. If taken from the name of a person, it usually recalls the name of the one who discovered or described it or was in some way concerned with it.
- (2) To avoid those which are very long and difficult to pronounce.
- (3) To avoid those which express a character common to all or nearly all the species of a genus.
- (4) To avoid using the names of little-known or very restricted localities, unless the species is quite local.
- (5) To avoid, in the same genus, epithets which are very much alike, especially those which differ only in their last letters.
- (6) Not to adopt unpublished names found in authors' notes, attributing them to their authors, unless these have approved publication.
- (7) To avoid compound specific epithets which include word stems from two or more languages (epitheta hybrida).

ANNOTATIONS

Recommendation 6b (1). Examples: *Staphylococcus aureus*, *Clostridium pasteurianum*, *Xanthomonas campestris*, *Bacillus viscosus*, *Kurthia zopfii*.

Recommendation 6b (2). Notwithstanding pronunciation difficulties and use of consonant combinations quite foreign to classic Latin, we accept a name such as *Cytophaga krzemieniewskae*. Madam Krzemieniewska was a noted contributor to our knowledge of certain groups of microorganisms, particularly the myxobacters.

Some specific epithets derived from names of diseases are long and cumbersome, as in the species names *Bacillus pneumoenteritidis-murium* (*Bacillus* of pneumoenteritis of mice), *Bacillus septicaemiae-anserum-exudativae* (*Bacillus* of exudative septicaemia of geese), or *Leptospira icterohaemoglobinuriae* (*Leptospira* of icterohaemoglobinuria). Two of these specific epithets have ten syllables and one has fourteen. Many long names were not validly published, or are for some other reason illegitimate.

Recommendation 6b (3). Rarely has this suggestion been ignored. A name such as *Micrococcus sphaericus* is obviously not distinctively descriptive of the species since presumably all species of this genus have spherical cells.

Recommendation 6b (4). This recommendation, taken from the Botanical Code originally, has relatively little significance in bacteriology. One may not know that the Vineland of *Azotobacter vinelandii* is in New Jersey. In some cases authors have chosen to use the mediaeval or late Latin place names, making the modern meaning obscure.

Recommendation 6b (5). Confusion of specific epithets in the same genus due to similarity in spelling has not been common in bacteriology. A hypothetical case may illustrate. There is a named bacterial species *Pseudomonas barkeri*, likewise a genus of orchids named *Barkeria*. Suppose a new species of a pseudomonad parasitic upon *Barkeria* were named *Pseudomonas barkeriae*. There might well be some confusion with two specific epithets in the same genus so closely resembling each other as *barkeri* and *barkeriae*. Even more difficult to differentiate in pronunciation would be the recognized *Pseudomonas woodsii* and a hypothetical *P. woodsiae* named from the fern genus *Woodsia*.

Recommendation 6b (6). This recommendation, found necessary in botany, has rarely, if ever, been of significance in bacteriology.

Recommendation 6b (7). Many such hybrid words used as specific epithets have been proposed, as *acidophilus* (acid-loving), *albochryseus* (whitish golden).

Additional Recommendations of the Botanical Code. The Botanical Code includes several Recommendations relating to specific epithets that are of interest. The Botanist is urged:

- (a) To use Latin terminations insofar as possible.
- (d) To avoid those formed of two or more hyphenated words.
- (e) To avoid those which have the same meaning as the generic name (pleonasm).
- (h) To avoid those which have been used before in any closely allied genus.

Additional Recommendations from the Zoological Rules are also pertinent.

- (1) The best specific name (epithet) is a Latin adjective, short, euphonic, and of easy pronunciation. Latinized Greek words or barbarous words may, however, be used. Examples: *gymnocephalus*, *echinococcus*, *aguti*, *koactli*, *urubitinga*.
- (2) It is well to avoid the introduction of the names (epithets) *typicus* and *typus* as new names for species or subspecies, since these names are always liable to result in later confusion.
- (3) The use of compound proper names indicating dedication, or of compound words indicating a comparison with a simple object, does not form an exception to Art. 2. In these cases the two words composing the specific name (epithet) are written as one word with or without the hyphen. Examples: *sanctae-catharinae* or *sanctaecatharinae*, *jan-maveni* or *janmaveni*, *cornu-pastoris* or *cornupastoris*, *corn-anguinum* or *cornanguinum*, *cedo-nulli* or *cedonulli*.
- (4) Expressions like *rudis plamusque* are not admissible as specific names (epithets).

RECOMMENDATION 6c. Avoid the use of the genitive and the adjectival form of the same specific epithet to designate two different species of the same genus.

ANNOTATIONS

Recommendation 6c. A specific epithet derived from the name of a person or locality may be a noun in the genitive or it may be converted into an adjective by use of an appropriate ending. There is a *Bacillus pasteurii* and a *Clostridium pasteurianum*. Should either species be transferred to the other genus there would be some danger of confusion. The two specific epithets *beigelii* and *beigelianum* have been used for the same species in combination with different generic names. In bacteriology a specific epithet is rarely in adjectival form when derived from the name of a person. Conversely, specific epithets from place names are rarely in the genitive.

RULE 7. Names of subspecies (varieties) are ternary combinations consisting of the name of the genus followed by specific and subspecific epithets in order.

Epithets of subspecies (varieties) are formed like those of species; when adjectival in form and not used as substantives they agree in gender with the generic name.

Neither within the same species nor within the same genus may two subspecies bear the same subspecific epithet.

If the species is divided into subspecies, the subspecific epithet of the subspecies containing the type of the species must be the same as that of the species.

NOTE. Names of species and of subspecies (varieties) from a nomenclatural point of view are coordinate (of equal value) and are subject to the same rules and recommendations.

NOTE. The words subspecies and variety are alternative designations for the same taxonomic rank; they are synonyms. The use of the term subspecies is preferable.

ANNOTATIONS

Rule 7. The name of a subspecies (or variety) is a trinomial made up of a generic name followed by a specific epithet and this, in turn, by a subspecific epithet. As provided in Rule 14, an author when proposing the name of a subspecies should make clear its subspecific status. The epithets preferably are separated by the abbreviation indicating a subspecies (variety), or this may be omitted. One may write *Bacillus subtilis* subsp. *niger* or *Bacillus subtilis* var. *niger* or *Bacillus subtilis niger*. The last listed method is most often used in biology, but has the disadvantage of not being directly distinguishable from an illegitimate trinomial name of a species. In other words, the name *Bacillus fluorescens liquefaciens* proposed as the name of a species was illegitimate because it had two specific epithets; it was not proposed as the name of a subspecies.

The sixth edition of Bergey's Manual of Determinative Bacteriology recognized two varieties or subspecies of *Bacillus subtilis*: *Bacillus subtilis atterimus* and *B. subtilis niger*. A third should have been recognized, *B. subtilis subtilis*, to include the type of the species.

Note that species may be divided into subdivisions of lower rank than subspecies and that subspecies may also be subdivided. These subdivisions are considered under Rule 8. Not all of the rules and recommendations applicable to species and subspecies are applicable to taxonomic ranks lower than subspecies.

Recommendations 6a, 6b and 6c apply to subspecific epithets as well as to specific epithets.

The name of a subspecies is a ternary combination; the use of a binary combination as the name of a subspecies is therefore not admissible. Example: *Mycobacterium tuberculosis* var. *avium* or *Mycobacterium tuberculosis avium*, not *Mycobacterium tuberculosis* var. *M. avium*.

RULE 8. Intrasubspecific subdivisions. Subdivisions of species (other than subspecies [varieties]) and subdivisions of subspecies are given vernacular names or designated by numerals or letters or, in special cases, are given names in Latin form. These are termed *intrasubspecific subdivisions* or *forms*. The names given to organisms included in *intrasubspecific subdivisions* need not conform to the rules governing the naming of subspecies and higher taxa. These rules do not determine the naming of forms of *intrasubspecific rank*.

NOTE. These subdivisions are regarded as of lower rank than subspecies. The terms commonly used to designate them are strain, biotype, serotype, morphotype, phagotype, group, phase, forma (or *forma specialis*), variant, mutant, stage, state.

ANNOTATIONS

Rule 8. The rules and recommendations of the three biological codes of nomenclature relating to subdivisions of species and subspecies are not uniform.

Bacteriological Code. The category subspecies is the lowest subdivision of species recognized and governed by all the Rules and Recommendations of this Code; "variety" is regarded as a synonym of "subspecies." Various terms indicated in the Note to Rule 8 above are of lower than subspecific rank. A collective name has not been recognized for the designation of subdivisions of lower rank than subspecies. The names given to *intrasubspecific forms* are frequently not Latin and are not subject to the rules governing the naming of bacteriological taxa. The term "*intrasubspecific*" was proposed in the Zoological Rules to include these lower subdivisions and is appropriate for use in bacteriology as well. Confusion will be avoided if bacteriologists will use the names only in a generally accepted sense, as indicated in Recommendation 8a.

Botanical Code. The botanists recognize a whole hierarchy of names of taxa subordinate to species. These are *subspecies*, *variety*, *subvariety*, *forma*, *subforma*. An example given is: "*Saxifraga aizoon* var. *aizoon* subvar. *brevifolia* forma *multicaulis* subforma *surculosa* Engler et Irmscher."

The Botanical Code states that the use of a binary combination for an *intraspecific* taxon is not admissible, but ternary combinations may be used provided the rank of the taxon is stated. For example, using the illustration given above, "*Saxifraga surculosa* Engler et Irmscher" is inadmissible, but "*Saxifraga aizoon* subforma *surculosa* Engler et Irmscher" is in proper form.

The Botanical Code (Art. 37) has the following pertinent statement:

Two subdivisions of the same species, even if they are of different rank, cannot bear the same subdivisional epithet, unless they are based on the same type. If the earlier subdivisional name (ternary combination) was validly published, the later one is illegitimate and must be rejected.

Zoological Rules. The Zoological Code includes all taxonomic ranks lower than subspecies under the general term *infrasubspecific*. An infrasubspecific form is defined as any subdivision of a species other than a subspecies, such as a "seasonal, sexual, or transitional form, an aberration, or other minority element within a species." The Zoological Code also includes a number of Rules and Recommendations relating to the use and recognition of infrasubspecific names (epithets).

- (1) *Time of publication.* The recognition of a distinct infrasubspecific category of names is recent. The problem is faced as to the allocation of names (epithets) as between subspecific and infrasubspecific. Names given before 1951 and after 1950 are treated separately.

Publication before 1951. A name is to be regarded as that of a subspecies if the author so indicated or if he did not indicate whether he regarded it as a subspecies or an "infrasubspecific" form. It is to be recognized as infrasubspecific only if expressly so indicated. The ultimate test is whether the name (epithet) was applied to a population (subspecific) or to some minority element within the population (infrasubspecific).

Publication after 1950. Names of less than specific rank, including those proposed as varieties, are to be regarded as infrasubspecific unless definitely designated as the names of subspecies.

- (2) *Nomenclatural status.*

- a. Names of species and subspecies on the one hand and the names of infrasubspecific forms on the other constitute mutually independent sections of nomenclature as regards both the Law of Priority and the Law of Homonymy.
- b. A name of an infrasubspecific form is to be coordinate with the names of all other infrasubspecific forms, but not with the names of subspecies or species.
- c. A name originally published as that of an infrasubspecific form may be elevated by a subsequent reviser to the status of a subspecific name or a specific name. In that event it is to rank (in its new status), for purposes of priority, from the date on which it was so elevated, and it is to be attributed to the author by whom it was so elevated.

There are also included several Rules and Recommendations relative to the form of acceptable publication and of citation of infrasubspecific names. The Rules also provide a formula for the citation of the name of an infrasubspecific form.

A citation of the name of an infrasubspecific form is to include (a) its binomen (if it is treated as a form of a subspecies, its trinomen), (b) after the specific (or subspecific) name, a comma followed by an expression of the status attributed to the form in question, and (c) the name of the infrasubspecific form.

RECOMMENDATION 8a. Authors of names of subdivisions of species of bacteria which are not treated as subspecies (varieties) should attend to the following recommendations and definitions:

(1) A strain is made up of the descendants of a single isolation in pure culture. It may be designated in any manner, as by the name of the individual responsible for its isolation (as *Corynebacterium diphtheriae* strain Park-Williams); by the name of a locality, by a number, or by some similar laboratory distinguishing mark. "Strain" may also be used to designate cultures of bacteria which correspond to cultivated "varieties" (cultivars) of higher plants in having some special economic significance.

ANNOTATIONS

Recommendation 8a (1). Rule 9 emphasizes the importance of preserving the particular strain of a species which was first isolated and studied in the preparation of the species description, i.e., the type culture of the species.

A particular strain of a species or subspecies may show marked differences in economic significance from other strains or isolations. *Corynebacterium diphtheriae* strain Park-Williams has long been used for commercial production of diphtheria toxin. The yield of the antibiotic streptomycin varies greatly with the strain of *Streptomyces griseus* used in its production. Strains of organisms which show marked differences in virulence, pigment production, enzyme yield, host specificity, host preference, or other characters may be labeled appropriately.

Certain mutant strains of microorganisms may require special identification because of their importance in providing a biochemical marker for cell-metabolism studies. For example, by irradiation of a bacterial culture followed by appropriate techniques of isolation, it may be possible to secure a mutant strain that differs from the parent culture in inability to synthesize leucine and thus exhibits a growth requirement for this amino acid in the culture medium. An organism having this characteristic may be known as "leucineless strain."

A strain which originates as a mutant may also be termed a *variant*, though the term variant does not necessarily indicate a true gene mutation. Variants are constantly arising, such as differently pigmented sectors in a colony, or a lactose-fermenting mutant in a culture of a non-lactose-fermenting organism.

RECOMMENDATION 8a (2). Type is a term which has frequently been used to designate a subdivision of a species, particularly in cases where the distinguishing characters are regarded as insufficient to justify the recognition of a subspecies. Types are often distinguished on the basis of antigenic characters. However, in view of the preferred use of the word "type" in a different sense as defined in Principle 11 and Rule 9, it is recommended that the terms serotype (or serological type), biotype (or physiological type), phagotype (or phage type) and morphotype (or morphological type) be appropriately substituted for type as a designation of a subdivision of a species.

ANNOTATIONS

Recommendation 8a (2). The continued use of the word "type" in microbiology with two very different meanings is a major source of confusion. The preferable and recommended use of "type" is that in the sense of "nomenclatural type" of a taxon and in phrases such as "type culture" and "type species", as noted in *Principle 11* and particularly *Rule 9*. This use of the word "type" is recommended.

The second common and less desirable use of the word "type" is for the designation of certain strains or cultures or groups of these within a species which show certain distinctive characters of less than subspecific rank. Certain substitute terms are recommended.

A "serotype" is a subdivision (infrasubspecific) of a species or subspecies distinguishable from other strains of the same species on the basis of its antigenic structure. It may be suitably named by use of the species name followed by "serotype" and this in turn by a suitable epithet or formula, as, for example, *Shigella flexneri* serotype 1a.

A "biotype" is a subdivision of a species, subspecies or serotype which may be distinguished from other subdivisions of the species by possession of some special or usefully diagnostic physiological character. An anaerogenic mutant of an aerogenic species of bacteria might be named by following the species name by "biotype *anaerogenes*" (or, anaerogenic biotype).

A "morphotype" is a subdivision of a species distinguished by possession of some special or unusual morphological character which may or may not be associated with a change in serological state. A capsulated variant of a bacterial species in which the cells are normally noncapsulated might be named by use of the species name followed by "morphotype *capsulatus*."

A "phagotype" is a subdivision of a species which is distinguished by its sensitivity to a particular bacteriophage or by a distinctive pattern of sensitivity to a set of specific bacteriophages. It may be characterized by the carriage of a symbiotic phage.

RECOMMENDATION 8a (3). The term "group" in bacteriology should be used with great care and be well defined if ambiguity is to be avoided. It has been used in somewhat different senses by those working in various fields of bacteriology. "Group" is used to designate congeries of organisms having common characteristics. In many cases the groups are based upon antigenic analyses, they are assemblages of related serotypes.

ANNOTATIONS

Recommendation 8a (3). Among the several bacteriological uses of "group" are the following:

- (1) "Group" is used by the Enterobacteriaceae Subcommittee of the International Committee on Bacteriological Nomenclature to emphasize the belief that recognition and diagnosis of the many serotypes is of fundamental significance. Those having some similarities in antigenic structure are placed together in "subgroups," then by use of various physiological tests larger groups are formed. The committee uses such designations as *Salmonella* group, *Escherichia* group, *Shigella* group where other bacteriologists would use the designations genus *Salmonella*, genus *Escherichia*, etc. An effort is made to avoid in some cases the conventional terminology of biology for what are regarded as good reasons.
- (2) Workers with certain bacterial genera and families have used the term "group" in antigenic analysis to designate species or subgenera (e.g., *Streptococcus* group A Lancefield), or varieties or subspecies (e.g., *Neisseria meningitidis* group I Scott). It has been suggested that the term group be reserved for primary serological divisions and designated by capital letters. Any serological subdivisions within the group should be designated as serotypes and distinguished by Arabic numbers (e.g., *Streptococcus pyogenes* Rosenbach group A Lancefield, serotype 1 Griffith).

The term "group" has not as yet achieved in bacteriology a generally accepted and consistent definition.

RECOMMENDATION 8a (4). The designation phase should be restricted to well-defined stages of a naturally occurring alternating variation.

ANOTATIONS

Recommendation 8a (4). Andrewes described diphasic variation of the flagella of many serotypes of *Salmonella*. This form of variation appears to be limited to the H (flagellar antigens) of species of *Salmonella* and certain closely related bacteria (Arizona group [Edwards]). The use of the term "phase" for a more permanent variation (e.g., S→R, V→W, "phases" of *Haemophilus pertussis*) is undesirable. Phase variation as here defined is thus far unknown outside the family *Enterobacteriaceae*.

RECOMMENDATION 8a (5). A form (forma) or special form (forma specialis) is a subdivision of a species of a parasitic or symbiotic microorganism distinguished primarily by adaptation to a particular host. It is named preferably from the scientific name of the host written in the genitive.

ANNOTATIONS

Recommendation 8a (5). This recommendation has proved useful in the naming of certain fungi which are selective as to host plant, but which show little or no consistent morphological differences. Some plant rusts, for example, are to be found on a number of species of grasses or varieties of the grasses, but they are physiologically so specialized or adapted that the forma found on one species or variety of host will not grow on some other. No adequate morphological distinguishing character is known. A form so specialized as to pathogenicity may be termed a *forma specialis*, designated by "f. sp.," followed by the name of the host species to which it is adapted. This method of identification has only occasionally been used in naming bacteria, though it may be useful in distinguishing bacterial plant parasites or symbionts. For example, Fang, Allen, Riker and Dickson noted a *forma specialis*, *Xanthomonas translucens* f. sp. *phlei-pratensis* on the grass timothy (*Phleum pratense*).

RECOMMENDATION 8a (6). State (or stage) is the name given to the rough, smooth, mucoid and similar variants which arise in cultures of many species of bacteria. These are usually regarded as alternating states which are often reversible, and indeed by some authors considered as part of a pleomorphic life cycle. They may be designated by some vernacular descriptive name.

Designation of Nomenclatural Types

RULE 9a. For each taxonomic group (taxon) there shall be designated a nomenclatural type. The nomenclatural type of a class or a subclass is an order, that of an order or suborder is a family, that of a family, subfamily, tribe or subtribe is a genus, that of a genus or a subgenus is a species, that of a species or subspecies is preferably an authentic culture, but it may be a specimen or preparation, illustration or description.

ANNOTATIONS

Rule 9a. The type concept has increasingly become the basis for all modern biological taxonomy. When taxa of any rank are divided or united, the use of the nomenclatural type concept leads to rational determination of the correct names to apply. Increasingly, stability and rationality in microbiological nomenclature is dependent upon maintenance of adequate type culture collections.

The directive of Principle 11, which states that for each named taxon there shall be fixed a *nomenclatural type*, is applied in Rule 9. The definition given in Principle 11 is:

A nomenclatural type is that constituent element of a taxon to which the name of taxon is permanently attached.

The meaning of the phrase "permanently attached" may be illustrated. The generic name *Bacillus* is the nomenclatural type of the family *Bacillaceae*. The family name *Bacillaceae* is "permanently attached" to the name of the genus *Bacillus* in the sense that there can be no family *Bacillaceae* that does not include the genus *Bacillus*. As usually interpreted the family *Bacillaceae* may include not only the genus *Bacillus* but also such other genera as are regarded as being sufficiently closely related in their characteristics to the genus *Bacillus*. The placement of *Bacillus* in *Bacillaceae* is objective, while the inclusion of any other genus is subjective; it depends on the decision of the student as to whether the other genus resembles *Bacillus* sufficiently. The genus *Bacillus* is the permanent element within the family *Bacillaceae*.

Similar is the meaning of "nomenclatural type" as applied to the type species of a genus. In the genus *Bacillus* the type species is *Bacillus subtilis*, and the generic name *Bacillus* is "permanently attached" to the species *Bacillus subtilis*. The genus *Bacillus* may be defined as the species *Bacillus subtilis* together with such other species as are recognized as having certain characters in common with those of *Bacillus subtilis*.

RULE 9b. Designation of the nomenclatural type of a taxon of higher rank than genus. The nomenclatural type of a family, subfamily, tribe or subtribe, whose name has been formed in conformity with the Rules, is that genus from whose name the name of the higher taxon has been derived. The nomenclatural type genus of a family whose name has been conserved,

but was not formed in conformity with Rule 3, may be fixed by the Judicial Commission. The nomenclatural type of a taxon of rank higher than family may be fixed at the time of its proposal by the author. If not so fixed, it may be designated by the Judicial Commission.

NOTE. If subdivisions of families (subfamilies, tribes, subtribes) are recognized, one taxon of each category must include the type genus of the family and its name should be derived from the name of the type genus.

ANNOTATIONS

Rule 9b. The family name *Bacillaceae* is derived from the generic name *Bacillus*, and this is the name of its nomenclatural type. There may be a subfamily *Bacilloideae*, a tribe *Bacilleae* and a subtribe *Bacillinae*, all with the nomenclatural type *Bacillus*.

The nomenclatural type of none of the named subclasses, orders and suborders in bacteriology has thus far been definitely fixed either by designation or by action of the Judicial Commission.

The family name *Enterobacteriaceae* has been placed on the list of *genera conservanda* to replace the rejected family name *Bacteriaceae*.

RULE 9c. Designation of the nomenclatural type of a genus or subgenus.

- (1) The nomenclatural type (type species) of a genus or subgenus is the name of the single species or of one of the species included when the name of the genus or subgenus was originally validly published.

NOTE. The expression "type species" is to be used rather than "genotype" or other expressions when referring to the type species of a genus.

- (2) If the author in the original publication of a generic or subgeneric name definitely selected a type species, this species shall be accepted as the nomenclatural type (type species) regardless of other considerations (type selection by original designation).

NOTE. The meaning of the expression "selected a type species" is to be rigidly construed. Mention of a species as an illustration or example of a genus does not constitute selection of a type.

- (3) If the author of a generic or subgeneric name in his original publication failed to designate a type species, the type may be selected by a subsequent author, and the author who first makes the choice must be followed unless it can be proved that his choice is not in accordance with the following rules:

- (a) If the genus, when originally published, included but one species, this species shall be the nomenclatural type (type species) (selection by monotypy).

- (b) If the genus, when originally published, included more than one species, the type species selected shall be one of these. However, species inquiringae, species doubtfully referred to the genus, species mentioned as in any way exceptional, species which definitely disagree with the generic description (provided others agree), and species which possess characters stated in the generic description as rare or unusual are to be excluded from consideration in selecting the type.

- (c) If none of the species named by an author in his original description and publication of a generic name can be recognized, that is, if no identifiable type species can be selected in accordance with the rules, the Judicial Commission may issue an Opinion declaring such generic name to be a *nomen rejiciendum* and without standing in nomenclature. However, if such generic name has come into use for identifiable species named subsequently, one of these later species may be selected by international agreement as the type species with the generic name ascribed to the author of the binomial designated as the type species. Such selection of a type species and recognition of the author of the generic name must be based upon an Opinion by the Judicial Commission, and if such Opinion is questioned, its validity shall be determined by action of the International Committee on Bacteriological Nomenclature.
- (d) The publication of a new generic name as an avowed substitute for an earlier one does not change the type of the genus.

ANNOTATIONS

Rule 9c. The use of the type method as a guide in taxonomy and nomenclature was first adopted by the zoologists, then by the botanists. Recognition of the principle by the bacteriologists came later, in part because of the difficulty in determining what should constitute the type of a species. Obviously no nomenclatural types were designated for the genera described by the early workers in bacteriology.

Botanical rules relating to the designation of type species. The Botanical Code and the Bacteriological Code are substantially the same in essentials. The Botanical Code provides that if the author of the generic name did not designate a type species, but gave to a species a specific epithet *typicus* or *typus*, that species shall be regarded as the type species.

Zoological rules relating to designation of type species. While quite differently phrased and much more complex and detailed, the Zoological Rules do not differ markedly in essentials from those of the Bacteriological Code.

The Zoological Rules permit tautonymy, that is, the use of the same word for the generic name and for the specific name (specific epithet) of the name of a species, as in the name *Trutta trutta*. Tautonymy is forbidden in Botany and Bacteriology (Rule 25).

The Zoological Rules state:

If a nominal genus, without originally designated or indicated type, contains among its original nominal species one possessing the generic name as its specific or subspecific name, either as its oldest available name or as a synonym, that normal species or subspecies becomes *ipso facto* type of the nominal genus.

The Zoological Rules also include a Recommendation with a list of precepts that should be followed in order of precedence in

designation of a type species by subsequent selection. Few or none of these seem to be applicable in bacteriological nomenclature.

A rule in zoology definitely fixes the use of the designation "type species." It reads:

The concept of a type species of a genus is invariably to be indicated by the expression "type species."

The following directive is also included as a Recommendation:

When referring to the type species of a genus, a zoologist should always use the expression "type species" rather than "genotype" or any other expression.

RULE 9d. The nomenclatural type of a species or subspecies. The nomenclatural type of a species or subspecies may be a living culture maintained in a bacteriological laboratory, more particularly in one of the international or national type culture collections.

NOTE. For a species which cannot be maintained in laboratory cultures or for which neither type cultures nor neotype cultures exist, the type is the original description, preparation or illustration.

NOTE. Definitions.

- (a) The term culture is to be interpreted as including every method of maintaining organisms in a living state (in a medium, in a host by passage, in cells or exudates, or desiccated).
- (b) A type culture is a living culture of an organism which is a descendant of the original culture or an isolation from which the author who first described the organism made his original description, which culture has been maintained pure, and which agrees in its characters with the original description.
- (c) A neotype culture is one which has been accepted by international agreement to replace a type culture which is no longer in existence. It should agree with the diagnosis given by the original describer and should be recommended by those workers familiar with the species, and their agreed recommendation approved by the Judicial Commission.

ANNOTATIONS

Rule 9d. Botanists and zoologists have developed a series of names to be used in connection with the fixing of type specimens of species of plants and animals.

Holotype (From the Greek, *whole* or *entire*, the *genuine* type). This is defined by the Botanical Code as follows:

A holotype (type) is the one specimen or other element used by the author or designated by him as the nomenclatural type. For so long as a holotype is extant it automatically fixes the application of the name concerned.

The definition given in zoology is:

The single specimen designated or indicated as "the type" by the original author at the time of the original publication.

The term holotype has found little use in bacteriology inasmuch as the nomenclatural types of bacterial species obviously cannot be the dried or preserved specimens used for higher plants and animals. A bacterial type should, if possible, be a living culture. This requirement complicates the picture of type designation in bacteriology and emphasizes the importance of Type Culture Collections being what the name indicates, collections containing authentic type cultures.

The definition of "type culture" given above in Rule 9 may be regarded as the bacteriological equivalent of the definition of a holotype.

Lectotype (From the Greek, *chosen* or *selected*). The Botanical Code reads:

A lectotype is a specimen or other element selected from the original material to serve as nomenclatural type when the holotype was not designated at the time of publication or for so long as it is missing.

The Zoological Rules define lectotype as:

A single specimen, selected, after the original publication, from a series of syntypes to be "the type"; such selection, in order to be effective, to be made known by publication.

The term lectotype has found little or no use in bacteriology.

Neotype (From Greek, *new*). The Botanical Code states:

A neotype is a specimen selected to serve as nomenclatural type for so long as all of the material on which the name of the taxon was based is missing.

The zoological definition is:

Neotype: A single specimen, identified with a nominal species already described and designated under the prescribed procedure as a unique standard of reference to replace a holotype or lectotype believed to be lost or destroyed.

A large proportion of the type cultures of the species of bacteria will necessarily be neotypes; authentic descendent cultures from original isolations by authors of names are frequently unavailable. Unfortunately, few of the cultures maintained in the recognized Type Culture Collections are authentic type cultures. In relatively few cases have type cultures been definitely designated. Study and definite designation of the type cultures (largely neotypes) is a necessary step in stabilization of bacteriological nomenclature.

Syntype is defined in zoology as:

One of a number of specimens of equal nomenclatural rank which formed all or a part of the material before the original author, in those cases where that author did not designate or indicate a holotype.

In botany the statement is:

One of two or more specimens or elements used by the author when no holotype was designated, or one of the two or more specimens simultaneously designated as type.

RECOMMENDATION 9a. When publishing the name of a new taxonomic group (taxon), authors should designate carefully the nomenclatural type of the taxon being named. This type determines the application of the name in the event of this taxonomic group being subsequently divided.

ANNOTATIONS

Recommendation 9a. In recent years many authors of new generic names have designated the type species. Castellani and Chalmers (1919) definitely designated *Bacterium coli commune* Escherich as the nomenclatural type of their new genus *Escherichia* with the name *Escherichia coli* (Migula) Castellani and Chalmers.

Waksman and Henrici named a new genus *Streptomyces*, with the type species *Streptomyces albus* (Rossi-Doria) Waksman and Henrici (*Streptothrix alba* Rossi-Doria, *Actinomyces albus* (Rossi-Doria) Krainsky).

RECOMMENDATION 9b. The utmost importance should be given to the preservation of the original "type" material on which the descriptions of new species and subspecies are based. If the microorganism is one which may be maintained in pure culture, an authentic culture designated as the type culture should be deposited with one or more of the national or international type culture collections.

Bearing in mind the morphological, biochemical, antigenic and virulence changes that may occur as the result of repeated subculture, every precaution should be taken to maintain such cultures with a minimum amount of change. It is likewise important that descriptions, illustrations and diagnoses of new species and subspecies be as complete as possible.

ANNOTATIONS

Recommendation 9b. Corresponding statements in the Botanical Code read:

It cannot be too strongly recommended that the original material, especially the holotype, of a taxon be deposited in a permanent responsible institution and that it be scrupulously preserved. Where living material has been designated as a type, appropriate parts of it should be immediately preserved.

The Zoological Rules have several provisions relative to type specimens.

Holotypes, syntypes and lectotypes are the property of science. Upon publishing a description of a new species, subspecies or "infrasubspecific" form, an author should affix a conspicuous label to the holotype or lectotype, indicating its type status, and should deposit the specimen in a museum or other institution where it will be safely preserved and will be available for study.

Publication of Names

RULE 10. Valid publication is treated as beginning for the bacteria with 1 May 1753, the date of publication of Linnaeus' *Species Plantarum*, edition 1.

ANNOTATIONS

Rule 10. The problem of fixing the beginning date for valid publication of names for plants was considered at several of the early Botanical Congresses. It was agreed that names published before the date of Linnaeus' *Species Plantarum* 1753 would not be considered as validly published. The two volumes of the *Species Plantarum* appeared respectively in May and August of 1753. For nomenclatural purposes it was decided that both volumes should be regarded as having been published simultaneously on 1 May 1753.

However, it was evident that the *Species Plantarum* did not give an adequate coverage of certain groups of plants, e.g., fungi and algae. It was decided to accept certain monographic treatments published at later dates as the beginnings of valid publication for such groups. As fixed in the Botanical Code, valid publication of the groups of interest to microbiologists are as follows:

Fungi: Uredinales, Ustilaginales and Gasteromycetes, 31 Dec. 1801.

(Persoon, *Synopsis Methodica Fungorum*).

Fungi Caeteri, 1 Jan. 1821 (Fries, *Systema Mycologicum*, Vol. 1).

Algae: Nostocaceae Homocystee, 1892-93 (Gomont, *Monographie des Oscillariés*, Ann. Sci. Nat. Bot. VI. 15:263-368; 16:91-264).

Nostocaceae Heterocystee, 1886-88 (Bornet and Flahault, *Re-vision des Nostocacées hétérocystées*, Ann. Sci. Nat. Bot. VII. 3:323-381; 4:343-373; 5:51-129; 7:177-262).

Desmidiaceae, 1848 (Ralfs, *British Desmidiaceae*).

Oedogoniaceae, 1900 (Hirn, *Monographie und Iconographie der Oedogoniaceen*, Acta Soc. Sci. Fenn. 27 [1]).

Myxomycetes, 1 May 1753 (Linnaeus, *Species Plantarum* ed. 1).

Bacteria, 1 May 1753 (Linnaeus, *Species Plantarum*, ed. 1).

At the Botanical Congress held in Brussels in 1910, various "points of departure" for the bacteria were considered. Vuillemin proposed that 1753 be adopted. Klebahn suggested that the work of F. Cohn (1870-76, *Untersuchungen über Bakterien*) was more suitable. His position was approved by Engler. Magnus contended that much work of systematic value had been accomplished before 1870 and proposed that the publication of Ehrenberg in 1786 [1838] should be the starting point. (Possibly Magnus intended Mueller 1786.) Vuillemin contended that if a date subsequent to 1753 be taken, it might well be 1910. The whole matter was finally deferred to the next Congress.

In preparation for this Congress Vuillemin (1913) published a paper in which he discussed bacterial classification and nomenclature. He concluded that the best approach was to determine which generic names were correct, to publish these names as *genera conservanda* and date all bacterial classification from 1915 when the list was to have been adopted by the next Congress. A study of Vuillemin's paper reveals that he himself does not formulate tenable bases for differentiation of genera and his reasons for choosing certain generic names and abandoning others will scarcely withstand critical analysis.

The Committee on Classification of the Society of American Bacteriologists suggested that the publication of the third edition of Zopf's *Die Spaltpilze* in 1885 be made the point of departure.

The first International Congress of Microbiology 1930 approved the following statement:

In view of the adequate provisions made for special regulations relating to the bacteria, and the feasibility of designating *genera conservanda* among the bacteria by international agreement, it is believed that the greatest stability will be conferred by the adoption of the publication of *Species Plantarum* by Linnaeus in 1753 as the point of departure for bacterial nomenclature. The adoption of this date is recommended.

This recommendation was presented to the London Botanical Congress in 1930 and approved. Through some oversight this date was not included in the Botanical Codes published in 1935 and 1952.

There apparently are no names of organisms now included among the bacteria that were proposed before 1773 (by Mueller). Before the year 1825 only two genera (*Polyangium* and *Serratia*) now included in the bacteria were described as plants, and before 1850 only three additional (*Beggiatoa*, *Leptothrix* and *Sarcina*). All other genera named were, until 1857, included in the Animal Kingdom.

The fixing of the date 1753 ensures that all published bacterial names must be considered.

In zoology the corresponding beginning date of valid publication is that of the tenth edition, 1758, of the *Systema Naturae* of Linnaeus. This is fixed as the work that inaugurated the consistent application of "binominal nomenclature" in zoology. This date of publication is accepted as the starting point of zoological nomenclature and of the Law of Priority. Any names of taxa in zoology published in other works in 1758 are to be considered as published after the tenth edition of the *Systemae Naturae*.

RULE 11. Publication is effected, under this Code, by sale or distribution of printed matter to the general public or to bacteriological institutions. No other kind of publication is accepted as effective (effective publication); communication of new names at a public meeting or scientific conference does not constitute effective publication.

Where reprints or separates from periodicals or other works are placed on sale or issued in advance, the date on the separate is accepted as the date of effective publication unless there is evidence that it is erroneous.

The date of acceptance of an article for publication as given in a publication does not indicate the effective date of publication and has no significance in determination of priority of publication of names.

ANNOTATIONS

Rule 11. The text of the Botanical Code (Art. 29) is similar. The reference to influence of date of acceptance on date of publication Art. 30 states:

The date of effective publication is the date on which the printed matter became available as defined in Art. 29.

The Art. 29 reads:

Publication on and after 1 Jan. 1953 of a new name in tradesmen's catalogues or in general and non-scientific newspapers, even if accompanied by a Latin diagnosis, does not constitute effective publication.

There is also a pertinent Recommendation:

Botanists and others are urged scrupulously to avoid publishing new names or descriptions in ephemeral publications, in popular periodicals, in any publication unlikely to reach the general botanical public, in those produced by such methods that their permanence is unlikely, or in abstracting journals.

Publication of names in botany cannot be effected by the issue of microfilm made from manuscripts, typescripts or other unpublished material.

Zoological Rules. The zoologists have distinguished between publication before 1951 and after 1950. The designation "duly published" is used apparently as the equivalent to "effectively published" in the Bacteriological and Botanical Codes. A name is duly published before 1951 only if it meets two requirements:

- (1) The document containing the name must have been reproduced by printing or other mechanical method that ensured that every copy is identical with every other copy.
- (2) The document must have been issued for purposes of record and consultation, and not for the sole consideration by special persons, nor for particular purposes, nor for a limited time.

The above requirements must be met by a name published after 1950, but, in addition, the publication must have been reproduced with ink on paper sufficiently durable to offer reasonable prospect of permanence.

The Zoological Rules recognize more clearly than either the Botanical or Bacteriological Codes that there are numerous mechanical methods of duplication other than by printing. It is, however, recommended that publication, other than by printing, of material affecting the status of a name should be avoided. In case of doubt, the question is to be referred to the Commission for decision.

The Zoological Rules specify eight actions that do not constitute publication. Some duplicate essentially the provisions of the other Codes. Of special interest is that "Distribution of separates before issuance of the book or paper to which they appertain" does not constitute publication. Further, it is recommended that separates "should not be distributed before the publication of the book or serial to which they appertain."

Publication in zoology is not effected by distribution of such duplicated material as microfilm or microcards.

It is recommended that whenever an author publishes a new name for a nominal genus, subgenus, species or subspecies, he should send notice promptly to a literature-recording serial (e.g., Zoological Record).

The Zoological Rules contain numerous additional provisions relating to publication. Many of these will be noted under other headings.

RULE 12a. A name of a taxonomic group (taxon) is not validly published unless it is both (1) effectively published (see Rule 11) and (2) accompanied by a description of the taxon or by a reference to a previously and effectively published description of it.

NOTE. The words "valid" and "validly published" as used in this Code mean "with standing in nomenclature", and the words "invalid" or "not validly published" mean "without standing in nomenclature."

ANNOTATIONS

Rule 12a. The Botanical Code adds the parenthetical phrase "(direct or indirect)" following the word "reference."

The Botanical Code also states that a combination (*i.e.*, the name of a species or of a taxon of subspecific rank) is not validly published unless "the author definitely indicates that the epithet or epithets concerned are to be used in that particular combination."

Botanists have added a rule which requires that, on or after 1 Jan. 1953, a new transfer or combination to be validly published must have its basionym* (the name-bringing or epithet-bringing synonym) clearly indicated with full reference to author and original publication.

Botanists have a long tradition of requiring for valid publication Latin diagnoses of newly described taxa of plants. At various times unsuccessful attempts were made to change the rule. However, there were many botanists who ignored the rule, particularly those who described fungi, algae and bacteria. Final agreement was reached that names of taxa published in languages other than Latin before 1 Jan. 1935 may be regarded as validly published. However, the Botanical Congress of 1930 approved the recommendation of the Microbiological Congress of 1930 that new names of taxa of bacteria are excepted from the general requirement. It was later agreed that new names of algal taxa published before 1 Jan. 1958 do not require Latin diagnoses (Botanical Code Art. 34, 1956).

These rules are of interest to all microbiologists in that valid publication of new names of bacterial and protozoan taxa may have the diagnoses in any language, all new names of fungal taxa must have diagnoses in Latin to be validly published, and after 1 Jan. 1958 the diagnoses accompanying new names of algal taxa must be in Latin. Further, a new name of an algal taxon is validly published after 1 Jan. 1958 only when accompanied by an illustration or figure showing the distinctive morphological features.

* Also spelled basonym.

Throughout biology the names given to all taxa must be Latin or Latinized to be recognized as validly published.

The Botanical Code (Art. 35) also requires that publication on or after 1 Jan. 1958 of the name of a new taxon of recent plants of the rank of order or below is valid only when the nomenclatural type is indicated.

RULE 12b. Valid publication is not effected by placing a name on a culture or preparation of bacteria in a collection or exhibit open to the public.

ANNOTATIONS

Rule 12b. New names of microorganisms have occasionally been placed upon cultures, as in Type Culture Collections, and have sometimes been printed in catalogues, without descriptions. Such names and new names placed upon museum specimens for public exhibition are not validly published.

In botany the placing of a new name upon a herbarium specimen (*exsiccatum*), even if accompanied by a description, does not constitute valid publication.

Publication of a new name in zoology is not effected by placing the name on the label of a museum specimen.

RULE 12c. A name (1) which is not accepted by the author who published it, or (2) which is merely proposed in anticipation of the future acceptance of the taxon concerned, or of a particular circumscription, position or rank of the taxon, or (3) which is merely mentioned incidentally is not validly published.

NOTE. Number (1) above does not apply to names or epithets published with a question mark or other indication of taxonomic doubt, yet published and accepted by the author. By "incidental mention" of a new name or combination is meant mention by an author who does not intend to introduce the new name or combination concerned.

ANNOTATIONS

Rule 12c (1). Beijerinck (*Arch. néerl. d. sc. exactes*, 1903, Sec. 2. 8:217) mentioned in a footnote to the publication in which he named the genus *Azotobacter* that *Parachromatium* might be preferable to show relationship to the genus *Chromatium*. It was not later used by the author and may be regarded as not validly published.

De Petschenko (*Zentr. f. Bakt. Abt. 1. Orig.* 56:90-92. 1910) described a parasitic infection of a protozoan by a spiral organism. In a footnote he suggested the generic name *Muellerina* with the species *M. paramecii*. Later (*Arch. Protist.* 22:248-298. 1911) he published a much more detailed description, repudiated his previously suggested names, and proposed the new names *Drepanospira* and *D. muelleri*. These latter, rather than the former, have been accepted by action of the Judicial Commission as validly published.

However, the author of a validly published name of a taxon may not later change the name except to bring it into conformity with the rules.

The Zoological Rules state that when a name is given it is presumed to be published for use in zoological nomenclature. However, if the author of the name makes clear that the name is not intended for such use, it has no status either for priority or for homonymy.

Rule 12c (2). Certain authors have desired to publish a symmetrical classification of bacteria, including generic names and descriptions for purely hypothetical genera. For example, Fischer (*Jahrb. wiss. Bot.* 27:41. 1895) proposed the generic name *Bactrinium* to include monotrichous, rod-shaped bacteria which produce endospores. The author included no species, and none has been subsequently described. The name was obviously proposed in anticipation of possible future acceptance and it was not validly published.

The Botanical Code contains a similar provision, and states further that if, on or after 1 Jan. 1953, two or more different names are proposed simultaneously for the same taxon by the same author, none of them is validly published.

A Zoological Commission has published the following pertinent commentary on "The Nature of a Systematic Name":

...The Commission is unanimously of the opinion that a *name*, in the sense of the Code, refers to the designation by which the actual objects are known. In other words, we name the objects themselves, not our conception of said objects. Names based upon hypothetical forms have, therefore, no status in nomenclature and are not in any way entitled to consideration under the Law of Priority.

RULE 12d. A name of a taxon is not validly published when it is merely cited as a synonym.

RULE 12e. The name of a taxon is not validly published by the mere mention of the subordinate taxa included in it.

RULE 12f. The date of a name or of an epithet is that of its valid publication. For purposes of priority, however, only legitimate names and epithets published in legitimate combinations are taken into consideration. In the absence of proof to the contrary, the date given to the work containing the name or epithet must be regarded as correct.

ANNOTATIONS

Rule 12d. Trevisan (*Rendiconti Real. Ist. Lombard. d. Sci. e Lett., Ser. 2*, 1879, 12:144) cited *Malleomyces equestris* Hallier as a synonym of *Micrococcus equestris* which he regarded as the causal organism of glanders. Inasmuch as all of Hallier's species were based upon mixed cultures and his names, therefore, illegitimate (see Rule 24g), this incidental citation as a synonym by Trevisan does not validate the name. *Malleomyces* must date as a generic name from its proposal by Pribram in 1933 (*Klassifikation des Schizomyceten*, p. 93).

Rule 12f. *Chondromyces crocatus* Berkeley and Curtis 1857 (in Berkeley, *Introduction to Cryptogamic Botany*, p. 313) is a name appended to an illustration without description. The description was published later (Berkely, *Grevillea*, 1874, 3:64) and valid publication was of the latter date.

RECOMMENDATION 12a. When names of new taxa are published in works written in a language unfamiliar to the majority of workers in bacteriology, it is recommended that the authors publish simultaneously the diagnoses in a more familiar language.

RECOMMENDATION 12b. Authors should indicate precisely the date of their works. In the case of a work appearing in parts, the last published sheet of the volume should indicate the precise dates on which the different fascicles or parts of the volume were published as well as the number of pages in each.

RECOMMENDATION 12c. When works are published in periodicals, the author should require the publisher to indicate on the separates or reprints the date (year and month, if possible the day) of publication and also the title of the periodical from which the work is extracted. Separates or reprints should always bear pagination of the periodical of which they form a part; if desired, they may also bear a special pagination.

RECOMMENDATION 12d. An author who describes and names a new taxon should indicate the rank of the taxon concerned and also the name and rank of the next higher taxon, (i.e., the name of the family to which a new genus is allocated, the name of the order in which a new family is placed).

RECOMMENDATION 12e. An author, when publishing the name of a new taxon, should designate the type and, in the case of a species or subspecies cultivable on artificial media, or otherwise preservable in pure culture in the living state, indicate the collection where the type strain or its equivalent is deposited.

ANNOTATIONS

Recommendation 12e. In Botany a new name of a taxon of rank of order or below published after 1 Jan. 1958 is valid only when the nomenclatural type is designated. If the nomenclatural type is a specimen the place where it is conserved should be indicated.

The zoologists have a *Rule* (not a Recommendation) which requires that a new generic or subgeneric name proposed subsequent to 31 Dec. 1930 be accompanied by a clear and unambiguous designation of a type species for validation. This rule indirectly provides that no new generic or subgeneric name is validly published if contained species are not designated or indicated. The Zoological Code also recommends that the author of the name of a new genus or subgenus should not only indicate but expressly designate the type species by name and, where the name of the species has previously been published, he should cite the bibliographic reference and its new species name (binomen).

RECOMMENDATION 12f. An author, when publishing a new generic or sub-generic name, should give its etymology and also that of a new epithet when the meaning is not obvious.

ANNOTATIONS

Recommendation 12f. The Botanical Code includes a similar Recommendation. The Zoological Rules recommend that the author of a generic name "based on a Greek or Latin word" should indicate the gender of the name and its etymology.

Compliance with this recommendation on the part of authors is most helpful in many cases. The fact that "*novaeboracensis*" means "of New York" is not readily discovered by reference to a Latin dictionary; one must know that the Latin name for York, England, was *Eboracum* and that New York is *Novum Eboracum*. Similarly, knowledge that "Jersey" is derived from the older Latin name *Caesarea* clears the meaning of "*novaetcaesareae*" as "of New Jersey."

RULE 13. The name of a genus or of a subgenus is not validly published unless it is accompanied

- (a) by a description of the genus or subgenus, or
- (b) by citation of a previously and effectively published description of the genus or subgenus, or
- (c) by citation of a previously and effectively published description of the genus as a subgenus or of the subgenus as a genus, or
- (d) in the case of a monotypic new genus based on a new species, by a combined generic and specific description, or
- (e) by a description of one or more species or by citation of a previous and effectively published description of one or more species included in the genus.

NOTE. A description of a new species assigned to a monotypic new genus is treated also as a generic description if the genus is not described.

Similarly a description of a monotypic new genus based on a new species is treated also as a specific description if the generic name and specific epithet are published together and the species is not separately described.

RECOMMENDATION 13a. A combined generic and specific description should mention the points in which the new genus differs from related genera.

ANNOTATIONS

Rule 13 (a). The publication of the generic name *Corynebacterium* Lehmann and Neumann (*Bakt. Diag.* 2:390. 1896) included a description of the genus and hence met one criterion for valid publication.

The publication of the subgeneric name *Sarcinococcus* Breed (Bergey's *Manual Det. Bact.* Ed. 6, p. 285) included a description of the subgenus and thus met one of the criteria for valid publication.

Rule 13 (b). The publication of the generic name *Rhodosphaera* Buchanan (*Jour. Bact.* 3:472. 1918) included a citation to a description of the genus *Rhodococcus* Molisch (*Die Purpurbakterien* p. 20, 1907), which generic name, though validly published, is an illegitimate later homonym of *Rhodococcus* Zopf (1891). The new generic name *Rhodosphaera* proposed thus met a requirement for valid publication.

Rule 13 (d). Beijerinck (*Cent. Bakt. Abt. 2.* 11:593. 1904) published a combined generic and specific description based on the new species *Thiobacillus thioparus* and thereby met the requirements of valid publication of the generic name.

RULE 14a. The name of a species is validly published only when its publication conforms to the following requirements:

- (1) It must be published as a binary combination consisting of a generic name followed by a single specific epithet.
- (2) It must be accompanied by a description of the species or by citation of a previously and effectively published description.

RULE 14b. The name of a subspecies (variety) is validly published only when its publication conforms to the following requirements:

- (1) It must be published as a ternary combination consisting of a generic name followed by a single specific epithet and this in turn by a single subspecific epithet.
- (2) It must be accompanied by a description of the subspecies or by citation of a previously and effectively published description.
- (3) The author must clearly state or indicate that a subspecies is being named.

ANNOTATIONS

Rule 14a. This rule in effect states that to be validly published and hence to have standing in bacteriological nomenclature the name of a species must conform to the requirement of Rule 6 that the name of the genus shall be followed by a *single* specific epithet. If followed by more than one specific epithet the species name is not a binary combination, does not conform to the binomial system of nomenclature, and is not validly published. A specific epithet, as noted under the Annotations of Rule 6, may consist of two or more related words which should be written solid or hyphenated.

Rule 14b. This rule is intended to obviate the confusion resulting from the naming of many microorganisms in the past. In some cases it is very difficult, if not impossible, to determine whether an author is proposing an illegitimate ternary combination as the name of a species or a legitimate ternary combination as the name of a subspecies. When a species is divided into subspecies, the subspecific epithet of the name of the subspecies which includes the type of the species must be the same as the specific epithet. The rule requires that an author, when he names a new subspecies, make clear that the ternary combination is that of a subspecies. (See Annotations under Rule 7.) One of the difficult tasks of the systematic bacteriologist in the future is to determine in the older literature of bacteriology the legitimate names of subspecies, and to discard the illegitimate ternary combinations used for names of species. Many cases will of necessity be reviewed by the Judicial Commission and Opinions rendered in order to remedy nomenclatural confusion.

Section 4

Citation of Authors and Names

RULE 15a. For the indication of the name (unitary, binary, or ternary) of a taxon to be accurate and complete, and in order that the date may be readily verified, it is necessary to cite the author who first published the name in question. An alteration of the diagnostic characters or of the circumscription of a group without exclusion of the type does not warrant the citation of an author other than the one who first validly published the name.

RULE 15b. A name conserved so as to exclude its type is not to be ascribed to the original author with such expressions as *emend.*, *mutatis charact.*, etc.; but the author whose concept is conserved must be cited as authority.

NOTE. Retention of a name in a sense which excludes the type can be effected only by conservation.

NOTE. See Provisions 4 and 5 for method of conserving names.

ANNOTATIONS

Rule 15a. Examples: *Plocamobacteriales* Pribram (or Pribram 1933); *Proteus* Hauser (or Hauser 1885); *Serratia marcescens* Bizio (or Bizio 1823).

Two or more authors may join in the publication of names of new taxa. It is often awkward and unnecessary to cite the names of all the co-authors, especially when there are more than two. It has become increasingly common to cite the name of the first author followed by *et al.* For example, Hauduroy, Ehringer, Guillot, Magrou, Prévot, Ronet and Urbain, in their *Dictionnaire des Bactéries Pathogènes*, have proposed a large number of new combinations (*comb. nov.*). To list seven names after each of these new combinations is obviously undesirable. The formula *Pasteurella ellingeri* Hauduroy *et al.* has been used.

In the first and second editions of Bergey's Manual of Determinative Bacteriology, the five members of the Committee on the Manual (Bergey, Harrison, Breed, Hammer and Huntoon) have been regarded as joint authors of all new names of taxa included. Citation is customarily to Bergey *et al.*

One of the most common errors in bacterial nomenclature is the ascription of scientific names to individuals who did not propose them. For example, Lauda (1930) in his section on *Bartonella* in the Kollé, Kraus and Uhlenhuth "Handbuch der pathogenen Mikroorganismen" uses the ascription "*Bartonella bacilliformis* Barton 1909." What Lauda intended to indicate, was that Barton discovered or described the organism. The correct ascription in this instance is *Bartonella bacilliformis* Strong, Tyzzer, Brues, Sellards and Gastiaburu, 1915 or, more briefly, *Bartonella bacilliformis* Strong *et al.*, 1915. This error of citing the discoverer or describer of an organism, rather than the author of its name, has led to much unnecessary confusion.

The Zoological Code includes a helpful definition of "author."

The author of a scientific name is that person who first published the name in connection with an indication, a definition, or a description, unless it is clear from the contents of the publication that some other person is responsible for said name and its indication, definition, or description.

RECOMMENDATION 15a. When the alteration of diagnostic characters or circumscription of a taxon has been considerable, the nature of the change and the author responsible may be indicated by adding suitable abbreviated words such as *emend.* (*emendavit*), *mut. char.*, *excl. gen.*, *excl. spec.*, etc.

RECOMMENDATION 15b. When a name with a description or reference to a description by one author is published in a work of another author, the word *in* should be used to connect the names of the two authors.

ANNOTATIONS

Recommendation 15a. Example: *Bacillus* Cohn 1872 *emend.* Migula 1894.

Recommendation 15b. Example: *Simonsiella muelleri* Schmid *in* Simons 1922.

RULE 16. When a genus, a subgenus, a species, or a subspecies (variety) is altered in rank but retains its name or epithet, the original author must be cited in parentheses, followed by the name of the author who effected the alteration. The same holds when a subgenus, a species, or a subspecies (variety) is transferred to another genus or species with or without alteration of rank.

ANNOTATIONS

Rule 16. Example: Philip 1943, proposed the name *Coxiella* for a new subgenus of the genus *Rickettsia*. The name of the subgenus with the author citation is *Coxiella* Philip, or *Coxiella* Philip 1943. Philip elevated the subgenus to the rank of genus, the generic name with author citation is *Coxiella* (Philip) Philip 1948. An organism regarded as the cause of syphilis was named *Spirochaete pallida*; with author's citation it is *Spirochaete pallida* Schaudinn and Hoffmann 1905. Vuillemin concluded that the organism was improperly placed in the genus *Spirochaete* and proposed the generic name *Spironema* with the species name *Spironema pallidum*, with author citation, *Spironema pallidum* (Schaudinn and Hoffmann 1905) Vuillemin 1905. Schaudinn noted that *Spironema* was illegitimate because it is a later homonym and proposed the new generic name *Treponema*; the species name with author citation is *Treponema pallidum* (Schaudinn and Hoffmann 1905) Schaudinn 1905.

Botanical Code. The Rule is essentially the same, but is more explicit in requiring that the name or epithet published by the original author was legitimate.

Zoological Rules. The rules are somewhat more explicit. When it is desired to cite the name of the author of the name of a taxon, the citation should follow the scientific name without separation by any mark of punctuation.

When a species or subspecies is transferred to another than the original genus or when the specific name (specific epithet) is combined with any other generic name than that with which it was originally published, the name of the author of the specific name (specific epithet) is retained in parentheses. Citation of the author of the new combination is desirable; his name follows the parentheses. In the Zoological Code rather more emphasis is laid upon the citation of the name of the author of the specific epithet, in the Botanical and Bacteriological Codes rather more upon the author of the combination.

Abbreviations of the names of authors. There is no provision in the Bacteriological Code for the abbreviation of the names of authors of scientific names. In general such abbreviations are unnecessary and inadvisable.

The Zoological Code recommends that in citation of the name of an author there should be no abbreviation unless the author be deceased and of such importance that the abbreviation would be readily recognized.

The Botanical Code differs from the Bacteriological and Zoological Codes in that it emphasizes the use of abbreviations of the names of authors. It specifically recommends such abbreviation and suggests standard methods of abbreviating names. This custom of abbreviation has come about in part because certain individuals gave a large number of names. That the abbreviation L. means Linnaeus and DC., A.P. De Candolle, is generally recognized.

RECOMMENDATION 16a. When citing a name published as a synonym, the words "as synonym" or "pro synonym" should be added to the citation.

When an author has published as a synonym a name from a manuscript of another author, the word *ex* should be used to connect the names of the two authors.

RECOMMENDATION 16b. When citing in synonymy a name invalidated by an earlier homonym, the citation should be followed by the name of the author of the earlier homonym preceded by the word "non", preferably with the date of publication added. In some instances, it will be advisable to cite also any later homonym or homonyms.

RECOMMENDATION 16c. In the citation of a *nomen nudum*, its status should be indicated by adding *nom. nud.*

RECOMMENDATION 16d. If a generic name antedated by one of its synonyms or by a homonym is accepted as a *nomen conservandum*, the abbreviation *nom. cons.* should be added to the citation.

RECOMMENDATION 16e. Names cited in synonymy should be spelled exactly as published by their authors. If any explanatory words are required, these should be inserted in brackets. If a name is adopted with alterations from the form as originally published, it is desirable that in full citations the exact original form should be appended.

ANNOTATIONS

Recommendation 16a. This is essentially the same as the corresponding Recommendation in the Botanical Code. Search has thus far revealed no good example in bacteriology. That given in the Botanical Code may illustrate.

Example: *Myrtus serratus* is a species name used in a manuscript by Koenig. It was published by Steudel as a synonym of *Eugenia laurina* Willd. It should be cited as *Myrtus serratus* Koenig *ex* Steudel, *Nomencl.* 321 (1821) *pro. syn.*

Recommendation 16b. Thaxter (1892) published the name *Myxococcus* for a genus of bacteria. Gonnerman (1907) later proposed *Myxococcus* as the name of another genus of bacteria. The name given by Gonnerman should be cited as: *Myxococcus* Gonnerman 1907 *non* Thaxter 1892.

Guillebeau 1890 proposed the generic name *Chlorobacterium*; Lauterborn 1915 proposed the same name for another genus of bacteria. The citation of the latter should be *Chlorobacterium* Lauterborn 1915 *non* *Chlorobacterium* Guillebeau 1890.

Recommendation 16c. A *nomen nudum* (naked name) has been defined in zoology as a name published without any definition, description or indication of the taxon to which it is intended to apply, and hence without status in nomenclature.

Example: Fischer 1895 proposed the generic name *Clostrinium* to include rod-shaped bacteria with a single polar flagellum and with cells which become spindle-shaped when sporulation occurs. No species was named by the author and none has since been described. It may be regarded as a *nomen nudum*.

Recommendation 16d.

Example: Guillebeau 1890 proposed the name *Chlorobacterium* for a bacterial genus. The generic name *Pseudomonas* Migula 1894, a later synonym of *Chlorobacterium* Guillebeau, was designated as a *nomen generis conservandum* (conserved name of a genus), and the generic name *Chlorobacterium* Guillebeau placed in the list of *nomina generum rejicienda* (rejected names of genera). A correct citation would be *Pseudomonas* Migula 1894 *nom. cons.*

Recommendation 16e. Authors sometimes spell names of taxa differently from the original or the accepted spelling. In some cases the change is intentional. For example, Enderlein 1917 preferred the spelling *Corynobacterium* of the generic name *Corynebacterium* Lehmann and Neumann 1896. In a list of synonyms each name should be spelled exactly as published by its author. Frequently the word *sic* in parentheses is appended to the citation to indicate that the spelling given is that of the author and not a misprint.

Changes in Names

as a Result of Segregation, Union, or Change in Rank of Taxa

RULE 17a. An alteration of the diagnostic characters or of the circumscription of a taxonomic group (taxon) does not warrant a change in its name, except as this may be necessitated by transference of the taxon, by its union with another taxon of the same rank (Rule 19), or by a change of its rank (Rule 22).

RULE 17b. When a genus is divided into two or more genera, the generic name must be retained for one of them, or (if it has not been retained) must be re-established. When a particular species was originally designated as the type, the generic name must be retained for the genus including that species. When no type was designated, a type must be chosen.

The same rule is applied when a subgenus is divided into two or more subgenera.

RULE 17c. The name of a taxonomic group must be changed if the nomenclatural type of the taxon is excluded.

ANNOTATIONS

Rule 17a. There is no warrant for changing the name of a taxon because the boundaries (circumscription) of the taxon are changed. The addition of new species to a genus may require a modification of the description (tabulation of diagnostic characters) of the genus, but not a change of name. For example, the genus *Pseudomonas* Migula 1894 is defined by some authors to include polar flagellate plant pathogens with yellow, non-diffusing pigment; others use the generic name *Xanthomonas* Dowson 1939 for the latter. Contraction or expansion of the boundaries of the genus itself is no reason for changing the name as long as the type species is retained within the genus.

Rule 17b. Example: When Donker (1926) proposed and named a new genus *Aerobacillus* to include those species of the genus *Bacillus* which are aerogenic, he correctly retained the generic name *Bacillus* for that portion which included the type species *Bacillus subtilis* Cohn. Winslow and Rogers (1906) divided the genus *Staphylococcus* Rosenbach (1884) into two genera named *Aurococcus* and *Albococcus*. One of the genera should have retained the name *Staphylococcus*, that containing the type species.

The corresponding Article in the Botanical Code has essentially the same wording.

The Zoological Code provides that when two or more restricted genera are formed by the division of a genus, the available name

must be retained for one of the genera, that containing the type species if one had been originally established.

Rule 17c. The Enterobacteriaceae Subcommittee in its report presented to the Rome Congress (1953, *Int. Bulletin*, 4:47) included *Aerobacter aerogenes* in the genus *Klebsiella*; this action deprived *Aerobacter* Beijerinck of its generally accepted type species. Edwards and Fife (1955, *J. Bact.*, 70:382) proposed that *Aerobacter* should be redefined with *Aerobacter cloacae* as type species. To become effective this would require international approval. Later, Hormaeche and Edwards (*Internatl. Bull. Bact. Nomen. and Tax.* 8:111-115, 1958) withdrew the earlier proposal and substituted for it a redefinition of the genus *Aerobacter* based on a motile strain which they designated *A. aerogenes*.

RULE 18a. When a species is divided into two or more species, the specific epithet must be retained for one of them, or (if it has not been retained) must be reinstated. When a type has been designated for the species, the specific epithet must be retained for the species including that type. When no type was designated, one must be chosen.

The same rule applies to subspecies (varieties); for example, to a subspecies (variety) divided into two or more subspecies (varieties).

RULE 18b. When a species is transferred to another genus (or placed under another generic name for the same genus), without change of rank, the specific epithet must be retained or (if it has not been retained) must be re-established unless one of the following obstacles exists: (1) the resulting binary name is a later homonym or tautonym or (2) there is available an earlier validly published specific epithet.

When the specific epithet, on transference to another generic name, has been applied erroneously in its new position to a different species, the new combination must be retained for the organism on which the epithet was originally based.

ANNOTATIONS

Rule 18a. Example: Frank (1890) named *Rhizobium leguminosarum* as the single species of the genus to include the bacteria responsible for nodulation of the roots of leguminous plants. Baldwin and Fred (1929) recognized several species described from the roots of different legumes. They rightly retained the name *Rhizobium leguminosarum* Frank as the type species to include the bacteria from species of *Lathyrus* and related genera.

The rule in botany is essentially the same.

The corresponding Article in the Zoological Rules states that when a nominal species (or a subspecies) is divided into two or more restricted species (or subspecies) the division is governed by the same Rules as in the division of a genus.

RULE 19. When two or more taxa of the same rank are united, the oldest legitimate name or (in species and subspecies) the oldest legitimate epithet is retained. If the names or epithets are of the same date, the author who first unites the taxa has the right to choose one of them, and his choice must be followed.

RECOMMENDATION 19a. Authors who have to choose between two generic names should note the following recommendations: (1) Of two names of the same date, to prefer the one which was first accompanied by the description of a species. (2) Of two names of the same date, both accompanied by descriptions of species, to prefer the one which, when the author makes his choice, includes the larger number of species. (3) In cases of equality from these various points of view, to prefer the more appropriate name.

ANNOTATIONS

Rule 19. The genera *Micrococcus* Cohn 1872 and *Staphylococcus* Rosenbach 1884 were united by Hucker who correctly chose the generic name *Micrococcus* as having priority.

The corresponding Article of the Botanical Code is essentially the same.

The Zoological Rules provide that when two or more genera or subgenera are united, the genus formed must take the oldest available generic or subgeneric name of its components. The rule just quoted applies as well when two or more species or subspecies are united to form a single species or subspecies.

Recommendation 19a. This Recommendation corresponds to that in botany.

RULE 20. When several genera are united as subgenera under one generic name, the subgenus including the type of the generic name used must bear that name unaltered.

ANNOTATIONS

Rule 20. Pederson 1945 included the genera *Thermobacterium* Orla-Jensen 1919, *Streptobacterium* Orla-Jensen 1919, and *Betabacterium* Orla-Jensen 1919, in the genus *Lactobacillus* Beijerinck 1901. The type species of *Lactobacillus* is *L. caasicus* (Beijerinck 1889) Beijerinck 1901. Pederson defined the subgenus *Thermobacterium* to include *L. caasicus* (*Lactobacillus* [*Thermobacterium*] *caasicus*). This recognition of *Thermobacterium* as a subgenus does not conform to Rule 20. The subgenus which includes the type species of the genus should bear the name *Lactobacillus*, of which the subgeneric name *Thermobacterium* (Orla-Jensen) Pederson becomes a synonym.

RULE 21. When several species are united as subspecies (varieties) under one specific name, the subspecies which includes the type of the species used must be designated by the same epithet as that of the species.

ANNOTATIONS

Rule 21. Smith 1948, in his revision of the species *Bacillus subtilis* Cohn 1872, included as subspecies *Bacillus atterimus* Lehmann and Neumann 1896 and *Bacillus niger* Migula 1900. He correctly re-named them *Bacillus subtilis* var. *atterimus* and *B. subtilis* var. *niger*. Under the Bacteriological Rule Smith's revision automatically created a third variety (subspecies) *Bacillus subtilis* var. *subtilis* of which the type culture is that of the species.

RULE 22a. When a taxon of a rank higher than a genus and not higher than an order is changed in rank, the stem of the name must be retained and only the suffix altered (-inae, -eae, -oideae, -aceae, -ineae, -ales), unless the name must be rejected under Section 6.

RULE 22b. When a subgenus becomes a genus, or a genus becomes a subgenus, the original name must be retained unless it is rejected under Section 6.

RULE 22c. When a subspecies (variety) becomes a species, or a species becomes a subspecies (variety), the original epithet should be retained unless the resulting combination is rejected under Section 6.

ANNOTATIONS

Rule 22a. When a tribe is raised to the rank of a family, the suffix *-eae* of the name must be changed to *-aceae*; for example, *Pasteurelleae* becomes *Pasteurellaceae*. The new name must not contravene the provisions of Rule 24.

Essentially the same provision is to be found in the Botanical Code.

The Zoological Rules prescribe definitely only the suffixes to be used for family and subfamily, namely, *-idae* and *-inae*. The basic concept is quite different from that of bacteriology and botany. A Family-Group of categories is recognized including all ranks between genus and suborder. All names of the Family-Group of categories are coordinate despite the endings of the names. For determination of priority each name dates from its original publication for any category within the family group. This priority is retained even though treated as belonging to a higher or lower category within the Family-Group. All Family-Group names are regarded as homonyms if they are identical apart from their terminations.

Rule 22b. Under the Bacteriological Code the name of a genus is not changed when it becomes a subgenus, nor is the name of a subgenus changed when it becomes a genus. This rule definitely fixes the coordinate nomenclatural status of generic and subgeneric names.

The Botanical Code does not recognize the equal priority status of generic and subgeneric names. The pertinent article (Art. 70) states that when the rank of a genus or an infrageneric (all ranks below genus) rank is changed, the correct name is the earliest legitimate name available in the new rank; in other words, a name of a genus or subgenus has no priority outside its own rank. An author who raises a subgenus to the rank of genus need not adopt the subgeneric name for the name of the new genus.

The Zoological Rule states that generic and subgeneric names are subject to the same Rules and Regulations and are nomenclaturally coordinate, thus resembling the Rule in the Bacteriological Code. When a later author changes the rank of a genus to that of a subgenus, the name of the genus becomes the name of the subgenus. Similarly a subgenus when raised to the rank of a genus retains its name.

Rule 22c. Names of species and subspecies are subject to the same Rules and Recommendations and are nomenclaturally coordinate. When a species becomes a subspecies or a subspecies becomes a species the epithet (specific or subspecific) is unchanged.

The Zoological Rules are essentially the same.

The Botanical Code on the contrary does not regard specific and subspecific epithets as nomenclaturally coordinate and states that in no case does an epithet have priority outside its own rank. An author who raises the rank of a subspecies to that of a species is not compelled to retain the subspecific epithet for that of the species.

Rejection and Replacement of Names

RULE 23. A legitimate name or epithet must not be rejected merely because it is inappropriate, or disagreeable, or because another is preferable or better known, or because it has lost its original meaning.

ANNOTATIONS

Rule 23. Neglect or misunderstanding of this rule has led in bacteriology to much nomenclatural confusion. It has been assumed by some bacteriologists that all names given to taxa should be appropriate or agreeable. But there is no rule sanctioning this interpretation in botany, bacteriology or zoology. This is in line with the principle that all three Codes aim at fixity of names. A name of any taxon is basically an arbitrary symbol. The Codes do, however, offer guidance on how best to coin appropriate names for new taxa. Bacteriological Rules governing the formation of names of taxa higher than genus require that the names be Latin or Latinized and in the plural number. Little use is made in bacteriology of names of taxa higher than order. It is recommended (Recommendation 2a) that the names of new orders and suborders be based upon the name of the type genus of the type family. The names of other taxa between suborder and genus *must be formed* (Rule 3) by the addition of the appropriate suffix to the stem of the correct name of the type genus. The name of a higher taxon based upon the name of its type genus cannot be inappropriate. Nevertheless, there have been many objections raised to the use of certain properly constructed family and other names because they are allegedly inappropriate. These objections are based upon fallacious reasoning. For example, an author concludes that the genera *Lactobacillus* and *Streptococcus* are so closely related (have so many characters in common) that they should be placed together in a family. Under the rules the family name must be based upon the name of the type genus. If the author chooses *Lactobacillus* as the type genus, the family name under the rules becomes *Lactobacillaceae*, including the two genera *Streptococcus* and *Lactobacillus*. The objection to this family name has been raised that the name *Lactobacillaceae* means "resembling milk rodlets" and is inappropriate because the other genus, *Streptococcus*, of the family does not include rods. The fallacy of this reasoning is evident if consideration is given to the true meaning of the family name *Lactobacillaceae* (*Lactobacillus*-like). It does *not* mean or imply that organisms belonging to the family *Lactobacillaceae* must be rod-shaped or related to milk. The genus *Streptococcus* has enough characters in common with the genus *Lactobacillus* so that it may well be included in the same family. The morphology is different, but in certain other significant characteristics *Streptococcus* resembles *Lactobacillus*.

The name of a genus may be "inappropriate" when it is descriptive of some character of one or more species of the genus, but not descriptive of all contained species. A generic name implying the presence of some color may be "inappropriate" when applied to certain species of the genus. This "inappropriateness" is no adequate reason for replacing the generic name by another.

In Recommendation 6b of the Bacteriological Code emphasis is laid upon the desirability of naming a species by use of a specific epithet "which, in general, gives some indication of the appearance, the characters, the origin, the history, or the properties of the species." A species name including such a specific epithet is appropriate. However, a Recommendation is a guide to good usage, but a name which is not in accordance with the provisions of a Recommendation is not illegitimate and cannot be replaced on the basis of inappropriateness.

The corresponding Article of the Botanical Code is essentially similar.

The Zoological Code states that when once published, a name is not to be rejected because of inappropriateness. A generic name such as *Apus* ("that which is footless") as applied to birds with feet is not to be rejected. One provision in zoology has no counterpart in bacteriology or botany: no name shall have any status in nomenclature that is "reasonably" calculated to offend on "political, religious or personal grounds." Such a name may be suppressed if upon application of any person to the International Commission it is found offensive in any language.

RULE 24. A name must be rejected if it is illegitimate, i.e., if it is contrary to a Rule. The publication of an epithet in an illegitimate combination must not be taken into consideration for purpose of priority.

A name of a taxon is illegitimate:

- a. If it was nomenclaturally superfluous when published, i.e., if the taxon to which it was applied, as circumscribed by its author, included the type of a name which the author ought to have adopted under one or more of the Rules.
- b. If it is a binary or ternary name published in contravention of Principle 9 and Rules 17-23, i.e., if its author did not adopt the earliest legitimate epithet available for the taxon with its particular circumscription, position, and rank.
- c. If its specific epithet must be rejected under Rule 25.
- d. If it is a later homonym of the name of a taxon of bacteria, plants, or protozoa; that is, if it duplicates a name previously and validly published for a taxon of the same rank based on a different type. Even if the earlier homonym is illegitimate, or is generally treated as a synonym on taxonomic grounds, the later homonym must be rejected. When an author simultaneously publishes the same new name for more than one group, the first author who adopts one of them, or substitutes another name for one of them, must be followed. NOTE: Mere orthographic variants of the same name are treated as homonyms when they are based on different types.
- e. If it is used with different meanings and so has become a long persistent source of error. A list of names (nomina ambigua) to be abandoned for this reason will be included under nomina rejicienda.
- f. If its application is uncertain (nomen dubium). A list of names to be abandoned for this reason will be included under nomina rejicienda.
- g. If the characterization of the group was based upon an impure or mixed culture. A list of names to be abandoned for this reason (nomina confusa) will be included under nomina rejicienda.
- h. If it was based upon an abnormality.

ANNOTATIONS

Rule 24a. The publication of the generic name *Dicrobactrum* Enderlein 1917 was superfluous because of the publication of *Serratia* Bizio 1823, based upon the same type species. *Calymmatobacterium granulomatis* Aragao and Vianna 1912 has priority over *Donovania granulomatis* Anderson, De Monbreun and Goodpasture 1945. The latter name is superfluous.

Rule 24b. The specific epithet used in the name of a species must be the earliest available under the rules. The specific epithet *marcescens* of the species *Serratia marcescens* Bizio 1823 was the first given, and renders illegitimate the use of the epithet of *Zaogalactinia imetrofa* Sette 1824, of the epithet in *Protococcus imetrophus* Meneghini 1838, and of that in *Monas prodigiosa* Ehrenberg 1849.

Rule 24d. *Pfeifferella* Buchanan 1918, proposed as a generic name in bacteriology, is illegitimate because it is a later homonym of *Pfeifferella* Labbé 1899, proposed as a name for a genus of protozoa.

Rule 24e. *Bacterium* Ehrenberg 1828 has as its type species *Bacterium triloculare* Ehrenberg 1828. The type species has never been identified or observed with certainty since Ehrenberg's first observation. The generic name has been applied by later writers in so many ways as to lead to major confusion and misunderstanding. The Judicial Commission issued an Opinion placing the generic name *Bacterium* Ehrenberg 1828 in the list of rejected names (*nomina rejicienda*), as an ambiguous name (*nomen ambiguum*).

Rule 24f. Names have been given to many taxa of bacteria, particularly to species, for which there are no descriptions adequate for identification, and of which there are no known cultures. Such names are placed in the list of *nomina rejicienda* as *nomina dubia*. Occasionally a later student may be able to reisolate and identify adequately an organism named in the list of *nomina dubia*, from which list it will then be removed.

Rule 24g. There are numerous instances in the literature of bacteriology in which the description of a purported new species was based upon a mixed or impure culture. Weinberg and Séguin (1918) described a new species under the name of *Bacillus aerofectidus*. This was later shown to be a mixed culture containing three species, two of them being *Clostridium welchii* (*C. perfringens*) and *C. oedematis*. The characters of the genus *Malleomyces* Hallier 1870 were derived from various fungi and bacteria erroneously supposed to be growth forms of a single organism. The name is illegitimate.

Rule 24h. A bacterial culture which became infected with a bacteriophage might produce colonies not characteristic of the species, and the supposedly different organism might be given a new name. Such a variant culture would be classed as an abnormality, and a new species name given to distinguish it would be illegitimate.

RECOMMENDATION 24a. Authors should avoid introducing into bacteriology as generic names such names as are in use in zoology.

ANNOTATIONS

Recommendation 24a. The author of a new generic name in bacteriology should make sure that a name he wishes to propose is not a later homonym of another generic name in bacteriology, in botany or in protozoology. He is concerned only with names that have been validly published; others have no nomenclatural status.

In bacteriology there exists no adequate list of validly published generic and subgeneric names. Such a list is in preparation and should be published as an appendix to future editions of the Bacteriological Code. The International Bureau for Plant Taxonomy and Nomenclature is preparing a card catalogue of validly published names of plant genera, including the bacteria. As this list is prepared the bacterial names will be published in the International Bulletin of Bacteriological Nomenclature and Taxonomy. Until this list is available, most questions of availability can be answered by reference to the indices of the Seventh Edition of Bergey's Manual of Determinative Bacteriology and its companion volume, the Index Bergeyana. In obscure or difficult cases and determinations, authors may request assistance from the Judicial Commission and its Editorial Board.

A list of validly published names of plant genera is in preparation as noted above in the form of a card catalogue. Until this is completed one should consult for generic names of flowering plants and ferns the Index Kewensis with its numerous supplements. Ainsworth and Bisby's Dictionary of the Fungi, Ed. 4, 1954, gives a virtually complete list of the generic names of fungi proposed up to about 1953. The Index of Fungi (issued by the Commonwealth Mycological Institute, Kew) lists generic names published since.

Becker prepared a list of generic names of protozoa taken from the list of generic names of the Animal Kingdom (Schulze and Kückenthal, Neave). The Zoological Record, with its carefully prepared lists of names of taxa proposed in zoology, is probably the best reference source in this field.

Botanical Code. The Rules of the Bacteriological Code relative to rejection of names and epithets do not differ materially from those of the Botanical Code on which they were originally based.

One botanical rule not duplicated in the Bacteriological Code relates to acceptance in botany of names of taxa transferred from the animal to the plant kingdom. A name of a taxon is illegitimate if it is the name of a taxon which at the time of such transfer becomes a homonym of the name of an existing plant taxon. Names of taxa transferred from the plant to the animal kingdom retain their botanical nomenclatural status for purposes of homonymy.

That there will be transfer of taxa to or from branches of zoology other than protozoology to botany is improbable.

Zoological Rules. A "Code of Ethics" which appeared in some earlier editions of the Rules has been rephrased. A zoologist who notes that a generic or specific name published by a living author as new is a later homonym and therefore unavailable should notify the author of the facts and give ample opportunity for a substitute name to be proposed by him.

When an organism is transferred from the animal to the vegetable kingdom, its generic name for purposes of homonymy retains its status under the Zoological Code.

RULE 25. A specific or subspecific epithet is illegitimate in the following special cases and must be rejected:

- a. When it is merely a word not intended as a specific epithet.
- b. When it is merely an ordinal adjective used for enumeration.
- c. When it exactly repeats the generic name (tautonym).
- d. When it is a later homonym within the same genus, that is, when it duplicates a specific epithet previously and validly published for a species of the same genus based upon a different type.
- e. When it was published in a work in which the Linnaean system of binary nomenclature for species was not consistently employed.

ANNOTATIONS

Rule 25. Note that this rule governs only certain special cases. A specific epithet is illegitimate also if it contravenes any rule of the Bacteriological Code, that is, it is illegitimate if its author did not use the earliest legitimate epithet available for the taxon being named.

Rule 25a. Authors sometimes do not completely identify by name an organism described, but use an expression such as *Clostridium sp.* (species). The expression means that the author regards the organism as belonging to the genus *Clostridium*, but with species indeterminate. The word *species* is "merely a word not intended as a specific epithet." In some fields of biology, particularly in botany, the pronominal adjective "qualis" (some kind of), also "*novus*" (new), have been used in place of a specific epithet before a suitable epithet has been decided upon. The use of *qualis* and *novus* in this sense does not preclude their use if desired as specific epithets, as in *Bacterium qualis* Steinhaus 1941 and *Plectridium novum* Huss 1907.

Rule 25b. Authors in some cases have used ordinal adjectives instead of specific epithets, particularly in enumeration of several new species. The sixth species of the genus *Bacillus* might be termed *Bacillus sextus*. *Sextus* as here used is not a legitimate specific epithet. This illegitimacy does not extend to the intentional employment of ordinal adjectives as specific epithets. There is a *Bacillus tertius* Henry 1916 and a *Clostridium sextum* Prévot 1940.

Letters of the Latin or Greek alphabet have sometimes been used in the enumeration of new species and subspecies, as *Bacillus a*, *Bacillus b*, etc. Letters thus used do not constitute legitimate specific epithets, although specific epithets such as *delta*, *alpha*, etc. may be legitimate. An "Opinion" relating to the Zoological Code states that "serial letters, as a, b, c, etc. are not acceptable as specific names."

Rule 25c. In bacteriology and botany it is the rule that a specific epithet is illegitimate if it exactly repeats the name of the genus (i.e., if it is a tautonym). When Castellani and Chalmers (1919) decided to make *Bacterium alcaligenes* Lehmann and Neumann 1899 the type species of a new genus *Alcaligenes* they were debarred from the use of *Alcaligenes alcaligenes* and chose *A. faecalis*. The rule in zoology approves, indeed encourages, the use of specific epithets which are tautonyms.

RULE 26. The name or epithet to be rejected according to Rules 23-25 is replaced by the oldest legitimate name, or (in a combination) by the oldest legitimate epithet which will be, in the new position, in accordance with the Rules. If none exists, a new name or epithet must be chosen.

NOTE. Where a new epithet is required, an author may, if he wishes, adopt an epithet previously given to the taxon in an illegitimate combination, if there is no obstacle to its employment in the new position or sense; the resultant combination is treated as a new name.

ANNOTATIONS

Rule 26. The Botanical Code has essentially the same wording.

This is the application of the Law of Priority, clearly stated in Principle 9. Examples: The generic name *Polyangium* Link 1809 replaced the generic name *Myxobacter* Thaxter 1892 when the earlier name with description was found by Thaxter. Similarly the species name *Myxobacter aureus* Thaxter 1893 became a synonym of *Polyangium vitellinum* Link 1809.

The species *Bacterium aeruginosum* Schroeter 1872 was later independently named *Bacillus pyocyaneus* by Gessard 1882. Migula proposed the new generic name *Pseudomonas* and recognized the specific epithet having priority, in *Pseudomonas aeruginosa* (Schroeter) Migula.

The Zoological Code under Law of Priority states that the name to be used for a genus or for a species must be the oldest name that fulfills three requirements. (1) The name must have been published and have been accompanied by an indication, or a definition, or a description of the taxon to which it appertains. (2) The author of the name must have consistently applied the principles of binominal nomenclature in the publication. (3) Any name published after 1930 must have had included in its publication a statement by the author in which he attempted to indicate the distinguishing characters of the taxon. Further, if published as a substitute for a rejected homonym, the publication must give a reference to the name replaced. If the name published is that of a genus or subgenus, it must have been published with a type species designated or indicated in accordance with the Rules prescribed for determining the type species solely on the basis of the original publication.

Section 7

Orthography and Gender of Names and Epithets

RULE 27. The original spelling of a name or epithet must be retained, except typographic or orthographic errors. When two or more generic names, or two or more specific epithets in the same genus, are so similar as to cause confusion, they are treated as orthographic variants of the same name or epithet.

NOTE 1. The phrase "original spelling" as used in this rule means the spelling employed when the name of the taxon was validly published. It does not refer to the use of an initial capital or small letter. Adjectives used as specific or subspecific epithets change gender endings when necessary to agree with the gender of the generic name.

NOTE 2. The use of a wrong (or an alternative) connecting vowel or vowels (or the omission of a connecting vowel) in a generic or subgeneric name or in a specific or a subspecific epithet gives rise to an orthographic variant.

NOTE 3. When there is doubt as to whether the spellings of the names of two taxa of the same rank or of two epithets are sufficiently alike to be confused, they should be referred to the Judicial Commission for an Opinion.

NOTE 4. An unintentional typographic or orthographic error later corrected by the author is to be accepted in its corrected form without prejudice as to original date and validity of publication.

NOTE 5. The spelling of the name of a taxon or an epithet derived from the Greek but not transliterated by its author into Latin form in accordance with classic usage (Appendix A) may be corrected as an orthographic error by the Judicial Commission and placed in the list of preferred spellings (see Recommendation 27a). The name of the taxon as originally published becomes an orthographic variant of the corrected name, but without prejudice to the validity of publication by the first author. Specific and other epithets and names of Greek origin differing merely by having Greek and Latin gender endings respectively are orthographic variants. Epithets having the same meaning and differing only slightly in form are considered as orthographic variants. The genitive and adjectival forms of a personal name are, however, treated as different epithets.

NOTE 6. Names of taxa and specific epithets are often compound words, sometimes formed from Latin stems, more often from Greek stems, sometimes (less correctly) from stems from two different languages. Such compound words formed from the same stems may differ only in the connecting vowel.

- a. In the formation of compound names of taxa and of specific epithets from the Latin the preferred connecting vowel is *-i-*. Such compound words that differ in spelling only by having the connecting vowel *-i-* or *-o-* are to be regarded as orthographic variants. Names of taxa which are such orthographic variants and based upon different types are to be regarded as homonyms. The spelling used for each taxon or specific epithet should be that used by the author when the compound was validly published.
- b. The combining vowel in Greek compounds in which the first component is a noun (substantive) or adjective is usually *-o-*. It may be omitted if the second component begins with a vowel. It is omitted when the first component ends in *-y* (glycyphyllus). Another combining vowel may be used if there is good Greek precedent, e.g., as in *Corynebacterium*. Names of taxa or words used as specific epithets which are Greek compounds and which differ only in the presence or absence of the combining vowel *-o-*, or have another combining vowel, are to be regarded as orthographic variants. If the names of taxa are based upon different types they are to be regarded as homonyms. The correct spelling is that of the name of the taxon or of the specific epithet used by the author in its initial and valid publication.
- c. Compound words derived from two or more different languages (*nomina hybrida*) are to be regarded as orthographic variants if they differ only in the combining vowel. The spelling first used by an author in the first valid publication should govern. If the two compounds are names of taxa having different types they are regarded as homonyms.

NOTE 7. The liberty of correcting a name or epithet must be used with reserve, especially if the change affects the first syllable, and above all the first letter of the name or epithet.

NOTE 8. Intentional Latinizations involving changes in orthography of personal names, particularly those of earlier authors, must be preserved.

NOTE 9. Diacritic signs are not used in names or in specific epithets in bacteriology. In names or epithets derived from words with such diacritic signs, the signs must be suppressed and the letters transcribed as follows:

1. ä, ö and ü become respectively ae, oe, ue. (German)
2. é, è and ê become e. (French)
3. ø (ö), æ (ä) and å become oe, ae and aa, respectively. (Scandinavian)

Where diphthongs are not indicated by special type, the diaeresis should be used where required to show that two consecutive vowels are to be separately pronounced (are in separate syllables).

NOTE 10. Certain consonants not found in classical Latin, namely w and y, and the rarely used k, may be employed in bacteriology for names of taxa and for specific epithets.

ANNOTATIONS

Rule 27. A typographic error is an unintentional misspelling which is found in a published name of a taxon or in an epithet. It is not always easy to determine whether a misspelling is unintentional. If the author later uses the word correctly spelled, the original spelling is regarded as unintentional, and the corrected spelling as legitimate.

An orthographic error is one resulting from the incorrect transliteration from languages having letters or an alphabet differing from the Latin. For example, De Bary named an organism *Bacillus megaterium*. It has been urged that classic transliteration from the Greek would give *megatherium* as the correct spelling. Both spellings have been used by subsequent authors. However, De Bary himself consistently used the spelling *megaterium*. An Opinion was issued confirming the use of the spelling *megaterium*. Similarly an Opinion was issued confirming the spelling *lysodeikticus* in the species name *Micrococcus lysodeikticus* Fleming as consistently used by the author and generally accepted by bacteriologists, although the correct transliteration from the Greek is *lysodicticus*.

Botanical Code. The rule is succinct: "The original spelling of a name or epithet must be retained, except that typographic or orthographic errors should be corrected."

It is noted that the words "original spelling" refer only to the spelling of the name when validly published; they do not refer to typography such as initial capital or small letter.

Zoological Rules state that every "Valid Original Spelling" is to be retained except for 22 emendations approved in Opinions "heretofore" and with the further exception that any author may propose to the Secretary that an emendation of an original spelling in general use be approved in the interests of stability and universality. The proposal becomes provisionally effective upon publication of a notice

in the Bulletin of Zoological Nomenclature. If no protest is submitted within a period prescribed by the Commission, the former "Valid Original Spelling" is added to the appropriate Official Index of Nomina Repicienda for priority but not for homonymy.

Rule 27. Note 1. Recommendation 27h states that specific epithets should not be capitalized, even when derived from the name of a person. If an author capitalized the specific epithet in a new species name, the epithet is not thereby made illegitimate, but it is recommended that subsequent authors use a lower case initial letter.

Since an adjective used as a specific epithet must agree in gender with the generic name with which it is used to form a species name, *Bacterium aeruginosum* Schroeter 1872 when transferred to the genus *Pseudomonas* became *Pseudomonas aeruginosa* (Schroeter) Migula 1900.

Rule 27. Note 2. The generic name *Corynebacterium* Lehmann and Neumann 1896 has the combining vowel *-e-* rather than the conventional *-o-*. However, this form was used by the Greeks; for example, the Greek lexicon contains compounds such as *corynephorus*. *Corynebacterium* conforms to classic usage. Enderlein (1917) proposed the spelling *Corynobacterium*. This is to be regarded as an orthographic variant of *Corynebacterium*. Had *Corynobacterium* been proposed as a name for a genus having a different type species it would have been a later homonym of *Corynebacterium*.

Rule 27. Note 3. See Provision 5 (p. 131) for procedure in requesting an Opinion. Several Opinions correcting orthographic errors have been issued by the Judicial Commission. Rule 3 and Rule 4 state that the name of a family shall be formed by the addition of the suffix *-aceae* to the stem of the name of the type genus. One can usually identify the name of the type genus from the name of the family. Many generic names in bacteriology are compounds with the final component *-bacter* or *-bacterium*, as in *Azotobacter* and *Corynebacterium*. The combining form (or stem) of the former ends in *-r* (genitive *-bacteris*). The combining form of the latter ends in *-i* (genitive *-bacterii*). However, family names such as *Achromobacteriaceae* and *Nitrobacteriaceae* have been repeatedly proposed, apparently on the assumption that *Nitrobacter* and *Achromobacter* have a stem ending in *-i*. The Judicial Commission in an Opinion ruled that the correct spelling is *Nitrobacteraceae* and *Achromobacteraceae*. However *Corynebacteriaceae* and *Chromobacteriaceae* are correctly spelled showing derivation from *Corynebacterium* and *Chromobacterium*, respectively.

Rule 27. Note 4. When typographical or orthographic errors are discovered in a publication of a new name, it is an act of courtesy to call the attention of the author to the error so that he may himself publish the correction.

Rule 27. Note 5. The specific epithet in the species name *Bacillus kaustophilus* Prickett 1928 had classical usage been followed, would have been spelled *caustophilus*. The Greek *kappa* should have been transliterated as a *c* rather than *k*. No suggested correction has been proposed in the literature. *Rickettsia akari* is generally accepted in the literature although the generic name from the same root is spelled *Acarus*.

Streptococcus erysipelatos and *S. erysipelatis* are orthographic variants; they are different transliterations of the same Greek genitive. Latinization as *S. erysipelatis* is preferable.

The genitive noun *pasteurii* and the adjective *pasteurianus*, though derived from the same patronymic Pasteur, are neither orthographic variants nor homonyms.

Some Latin words were spelled alternatively with an initial vowel or with an *h* preceding the vowel. This in some cases was due to two different transliterations of Greek words with an initial *spiritus asper* (transliterated as *h*). Linnaeus used as a specific epithet the Latinized Greek *abrotonum* rather than the classical transliteration *habrotonum*; for the species *Artemisia abrotonum*, the Linnaean spelling should be followed.

Rule 27. Note 7. The name of Pasteur may be Latinized as *Pastor*. Both forms have been used in forming names and epithets: *Pasteurella* Trevisan 1885; *Clostridium pasteurianum* Winogradsky 1895; *Urobacillus pasteurii* Miguel 1889; *Saccharobacillus pastorianus* Van-Laer 1892.

Gaillonelle has been Latinized with resultant *Gallionella Ehrenberg* 1835. There is also a *Gaillonella* Bory de St. Vincent 1823.

Rule 27. Note 8. The only diacritic sign permissible in the spelling of names and epithets in bacteriology is that of the diaeresis (Gr., a division) which may be placed above the second of two consecutive vowels to indicate the two vowels are to be separately pronounced (are in separate syllables), and not to be regarded as a diphthong. For example, the specific epithet *aeruginosa* (as in *Pseudomonas aeruginosa*) is derived from the stem *aer-* from *aes*, *aeris* = bronze, copper, in which initial *ae-* is a diphthong. However, the Greek $\alpha\eta$ = *aē* is not a diphthong. Many names and epithets in bacteriology are derived from the Greek $\alpha\acute{\eta}\rho$ = *aēr* = air; in such words to indicate that the *a* and *ē* are in two syllables, the sign of the diaeresis may be used, hence *Aërobacter aërogenes* (Kruse) Beijerinck but *Bacillus aeris* Chester.

Several European languages which employ the Latin alphabet modify certain vowels by use of diacritical marks.

The modern German umlaut may modify the vowels *a*, *o* or *u* to *ä*, *ö* or *ü*, which may alternately be written *ae*, *oe* and *ue*. The latter alternative must be chosen when German words are Latinized; *Salmonella schottmuelleri*, not *S. schottmülleri*; *Schuetzia*, not *Schüttzia*; *Actinomyces foersteri*, not *A. försteri*; *Pedioplana haeckelii*, not *P. hückelii*; *Lochnisium*, not *Löhnisium*.

The French accents of the letter *e* (*è*, *é* and *ê*) are not transferred when a French word is Latinized.

Some Scandinavian languages have diacritic marks for the vowels *o* and *a*. They are *ø* or *ö*, *æ* or *ä* and *â* which on Latinization become *oe*, *ae* and *aa* respectively.

An important group of languages employ the Cyrillic alphabet (Russian, Serbian, Ukranian, Bulgarian, etc.). The problem of transliteration is complicated by the fact that in some cases sounds are represented by the Cyrillic letters which have phonetically no equivalent in the Roman alphabet. Romanization is effected by the use of various diacritic marks as well as by letter combinations. Latinization of words in languages printed in Cyrillic must be preceded by romanization, then transliteration into Roman letters with the conventional diacritic marks. Latinization is completed by elimination of the diacritic marks and the use of appropriate Latin endings. Obviously the pronunciation of the letters of the Latinized word will not correspond to those of the original Cyrillic. (For a discussion of transliteration of Cyrillic for use in nomenclature see Paclt, Jiri. *Taxon* 2:159-166. 1953).

Botanical and Zoological Codes. There are no essential differences from the Bacteriological Code. Diacritic marks are suppressed in formation of Latinized words.

RECOMMENDATION 27a. When a name or epithet for use in bacteriological nomenclature is derived from a Greek word, the transliteration to Latin form should conform to classic usage. Appendix A (q.v.) to this Code may be used as a guide. If a later author corrects in a valid publication the spelling of a name or epithet incorrectly transliterated from the Greek, the correctly spelled word may be regarded as an orthographic variant of the name or epithet.

RECOMMENDATION 27b. When it is necessary to choose between words which have been validly published as names of taxa or as specific or sub-specific epithets and which differ in spelling only because of faulty or alternative transliterations of Greek to Latin, or because of alternative transfer of endings denoting gender or oblique cases (particularly the genitive) from Greek to Latin, it is recommended that choices be governed by the provisions of Appendix A to this Code, (q.v.).

RECOMMENDATION 27c. For scientific names of taxa it is advisable to use another font from that used for the remainder of the text, or to space the letters, or to use some similar device appropriate to the text. Typewritten scientific names should be underlined.

ANNOTATIONS

Recommendation 27c. Generally in biology it is customary to print names of genera and species using a different type from that used in the body of the text. The most common device is the use of italics (*Bacillus subtilis*). Occasionally bold face type is used (**Bacillus subtilis**). Another device employed is to increase the space between letters (B a c i l l u s s u b t i l i s); this is common in German publications.

The Zoological Rules recommend the use of some type other than that used for the text. However, Follett (1955) in a footnote suggests that the zoological Recommendation "should expressly exclude the name of any suprageneric category." Many authors in zoology use italics only for names of species and subspecies, not for names of families, orders, etc.

The International Code of Botanical Nomenclature adopted by the Eighth International Botanical Congress, Paris 1954 (published 1956), uniformly uses "another font than that used for the remainder of the text," for the names of all taxa, not only for names of species, but also for the names of genera and all suprageneric taxa. In some paragraph headings the names are in capitals, in all other places the names of taxa are in italics. However, in Articles 73 and 74 dealing with "Orthography of Names and Epithets," there are no directives or recommendations for such use.

In practice, some botanists and botanical journals use italics (or other distinctive type) for names of species but roman type for names of higher groups.

A pamphlet published for the Royal Society, "General Notes on the Preparation of Scientific Papers" (1950 p. 16), under the heading "Botany" makes the following statement:

"The scientific names of plants are Latin binominals (binomials) and are printed in italics. The scientific names of higher groups (orders, classes and families) are printed in ordinary roman type with a capital if in Latin form."

RECOMMENDATION 27d. When a new name for a genus or subgenus is taken from the name of a person it should be formed in the following manner:

- (1) When the name of the person ends in a vowel or *y*, the letter *a* is added, except when the name of the person ends in *a*, when *ea* is added.
- (2) When the name of a person ends in a consonant the letters *ia* are added, except when the name ends in *er* when *a* is added.
- (3) When the name of a person has been Latinized and ends in *us*, this termination is dropped before adding the suffix.
- (4) The name of a bacterial genus or subgenus may be formed from the name of a person by the addition of a diminutive ending.
- (5) The syllables which are not modified by these endings retain their original spelling, even with the consonants *k* and *w* or with groupings of vowels or consonants not used in classical Latin.

ANNOTATIONS

Recommendation 27d. Relatively few generic names of bacteria have been taken from names of persons. Of the approximately 168 bacterial generic names recognized in the 7th edition of Bergey's Manual of Determinative Bacteriology, 22 are from patronymics; of the 18 generic names of rickettsiae, 10 are thus derived.

Recommendation 27d (1). Among the generic names of bacteria derived from names of persons ending in a vowel are *Gaffkya*, *Serratia*, *Noguchia*, *Nevskia*, *Beggiatoa*, *Cowdria* and *Beneckea*. No example has been found in which the name of a bacterial genus is derived from a person's name ending in *a* by the addition of *ea*. In botany *Collaea* is taken from *Colla*. The generic names thus formed are feminine nouns. The botanical recommendation is essentially the same. The *Zoological Code* recommends that generic names derived from the names of persons ending in the vowels *e*, *i*, *o*, *u* or *y* take the ending *-us*, *-a* or *-um*. However, in zoology it is relatively rare for an ending other than *-a* to be proposed. Of seven examples of such names listed by Follett all end in *-a*, all are feminine nouns. The option to create neuter or masculine nouns is rarely exercised. In zoology, personal names ending in *-a* add *-ia* (in contrast to the botanical and bacteriological *-ea*) in formation of generic names.

Recommendation 27d (2). Examples: *Escherichia*, *Erwinia*, *Donovania*, *Kurthia*, *Pasteuria*, *Nocardia*, *Borrelia*, *Rickettsia*. The recommendation that *-a* be added to names ending in *-er* has been commonly ignored, and *-ia* has been added, as in *Neisseria* and *Listeria*. In *Zinssera* the recommendation has been followed.

The *Botanical Code* includes the same Recommendation.

The *Zoological Rules* recommend that personal names ending in a consonant take the ending *-ius*, *-ia* or *-ium*, making masculine, feminine or neuter generic names, as *Selysius*, *Lamarckia*. Here again the alternative of forming a feminine noun is usually chosen.

Recommendation 27d (3). In the earlier writings in biology it was common practice to Latinize the names of persons. For example: Carl von Linné usually Latinized his name to Carolus Linnaeus. The plant generic name *Linnaea* was formed by dropping the ending *-us* and adding *-a*.

Recommendation 27d (4). Generic names are frequently taken from the name of a person by adding diminutive and sometimes other endings.

In biology many suffixes have been used to latinize personal names for use as generic names. Kuntze (*Revisio generum plantarum* 1781) lists 20 "pure suffixes" (*reine Suffixe*) from botanical writings. The use of a diminutive ending is frequent in bacteriology. The following have been used:

-ella, -iella. Commonly *-ella* is used as a diminutive suffix to personal names that do not end in a sibilant: *Salmonella* from Salmon, *Shigella* from Shiga, *Pasteurella* from Pasteur, *Bordetella* from Bordet, *Veillonella* from Veillon, *Bartonella* from Barton, *Grahamella* from Graham; an exception is *Naumanniiella* from Naumann. Sometimes *-iella* is added to names ending in *-s* or *-x*: *Klebsiella* from Klebs; *Simonsiella* from Simons; *Coxiella* from Cox; *Rickettsiella* from Ricketts; an exception is *Moraxella* from Morax. In some cases a consonant is inserted for euphony: *Miyagawanella* from Miyagawa. Or a final vowel is dropped: *Brucella* from Bruce.

-illus, -illa, -illum. The first of these Latin diminutive endings has been used by Heller in coining more than twenty names for genera carved from the genus *Clostridium* as: *Henrillus* from Henry; *Novillus* from Novy; *Macintoshillus* from MacIntosh.

-iota, the name of the smallest letter of the Greek alphabet, has been used in forming the generic name *Colesiota*.

Recommendation 27d (5). There was no Latin letter *w*, but words containing the letter *w* are Latinized with retention of the *w* as *Wolbachia* from Wolbach. The letter *k* was used in old Latin, but in classical Latin was replaced by *c*. Personal names from languages other than Latin or Greek retain the *k* when Latinized, as *Kurthia* from Kurth. The letter *y* was introduced into the Latin alphabet for the correct transliteration of the Greek letter *upsilon*, for which there was no exact Latin equivalent, and is recognized in bacteriological Latin, as in *Wolhynia* from Wolhyn.

RECOMMENDATION 27e. A new specific or subspecific (varietal) epithet taken from the name of a man may assume either a substantival or an adjectival form.

When the epithet is a substantive, the modernized Latin genitive is formed in the following manner:

- (1) When the name of a person ends in a vowel or -y, the letter -i is added.
- (2) When the name ends in a consonant, the letters -ii are added (thus, *welchii* from Welch) except when the name ends in -er, when -i is added (thus, *barkeri* from Barker).
- (3) When the personal name is already Latin or Greek or has been latinized, the appropriate Latin genitive should be used.
- (4) The syllables which are not modified by these endings retain their original spelling, even with the consonants k and w or with groupings of vowels or consonants not used in classical Latin.

When the epithet is an adjective, it is formed by the addition of an appropriate ending.

ANNOTATIONS

Recommendation 27e. A specific epithet taken from the name of a man is usually placed in the genitive (possessive) case; sometimes an adjective is formed by use of an appropriate Latin ending.

Names of men that are already Latin or have been Latinized form the conventional Latin genitive. Carl von Linné Latinized his name to Linnaeus, with the genitive *Linnaei*. It is customary to regard names ending in -a as in the first declension forming the genitive by adding -e, as *Shigae* from Shiga, *Miyagawae* from Miyagawa.

Names of men in languages other than Latin are first Latinized. The Romans had several forms of proper names, praenomina, cognomina, names of gentes (clans). With few exceptions these had -us as an ending, in most cases the name ended in -ius. In conventional formation of the genitive the -ius becomes -ii. However, the Latins noted difficulty in pronouncing genitives of names in which the -ius is preceded by a vowel. The -ii in such cases was contracted and became -i; thus the genitive of Gaius is Gai (not Gaii), of Pompeius is Pompei (not Pompeii); hence the recommendation that personal names ending in a vowel other than -a form the genitive by addition of -i: as *Sonnei* (not *Sonneii*) from Sonne, *Noguchii* (not *Noguchiii*) from Noguchi.

Most Latin personal names ending in -ius had a consonant preceding this ending. Two methods of forming the genitive were commonly employed. In perhaps the majority of examples found in Latin the genitive ending is -ii, but in some it is -i. One finds *Plinius*, *Plini*; *Aesculapius*, *i*; *Curtius*, *i*. On the other hand scores of names are recorded which end in -ius and have -ii in the genitive, as *Arcesius*, *ii*; *Curtilius*, *ii*; *Cuspius*, *ii*; *Mallius*, *ii*.

The Bacteriological Code agrees with the Botanical Code in recommending that in Latinization of non-classic names ending in a consonant the genitive is to be formed by adding *-ii*.

The Zoological Rules on the other hand recommend that in all cases the genitive of non-classic Latin names should be formed by the addition of *-i*. The recent (1957) Bradley Draft of the proposed revision of the Zoological Code accepts the correctness of either genitive ending *-i* or *-ii*.

This difference between the recommendations of the codes is sometimes confusing. The specific epithets derived from proper names have frequently been formed by bacteriologists by the addition of *-i*. In some cases names of species in different genera may have specific epithets derived from the name of the same person, one author used the ending *-ii*, the other *-i*. Rule 27 requires that the original spelling of names or specific epithets should be accepted, even though not formed in conformity with a recommendation. In many cases specific epithets in the species names of bacteria have been changed by a later writer to comply with the Recommendation 27e.

Genitives formed from the personal name of a man by addition of *-ii* in the one case and *-i* in the other should be regarded as orthographic variants of the same word. Within the same genus two species names with specific epithets differing only in the genitive ending are to be regarded as homonyms.

Some authors "correct" all genitives ending in *-i* to *-ii* even though there is no authorization of such change under the rules.

When an epithet in adjectival form is based upon the name of a man, it is customarily formed by the use of the adjectival endings *-anus* or *-ianus*. When the name ends in a vowel other than *-a*, the ending *-anus* is preferred. If the word ends in *-a* or *-us* this ending is altered to *-anus*, if the word ends in *-ius* or *-ia* or in a consonant the adjective ends in *-ianus*. Examples: *pasteurianus* in *Acetobacter pasteurianus* (from Pasteur), *Acetobacter kuetzingianus* (from Kuetzing), *Rhodospirillum molischianum* (from Molisch), *Pseudomonas tonelliana* (from Tonelli), *Xanthomonas henmiana* (from Hemmi).

RECOMMENDATION 27f. The same provisions apply to epithets formed from the names of women. When these have a substantival form they are given a feminine termination.

ANNOTATIONS

Recommendation 27f. When the name of the woman ends in *-a* the genitive is formed by adding *-e*, as *stellae* from *Stella*, *mariae* from *Maria*, *krzemienievskae* from *Krzemienievska*.

The genitives of names of women ending in a vowel other than *-a* or that end in a consonant are formed by adding *-ae*.

Women's names that are in Latin form or that have been latinized form the genitive in accordance with the rules of Latin grammar, as *Beatricis* from *Beatrix*.

When the specific epithet is an adjective derived from a woman's name an appropriate adjectival ending is used, usually *-anus*, *-a*, *-um*, or *-ianus*, *-a*, *-um*. Inasmuch as the gender of an adjectival specific epithet agrees with the gender of the generic name, the adjective does not show definite relationship to the name of a woman. The use of the genitive substantive may therefore be preferred. The genitive *smithii* shows derivation from the name of a man, *smithae* from the name of a woman, but *smithianus* does not indicate whether a man or a woman is honored.

RECOMMENDATION 27g. New specific (or other) epithets should be written in conformity with the original spelling of the words from which they are derived and in accordance with the rules of Latin and Latinization.

RECOMMENDATION 27h. Specific epithets, even those derived from names of persons, should not be capitalized.

ANNOTATIONS

Recommendation 27h. During the first several decades following the introduction of the Linnaean binomial naming of species, it was customary, particularly in botanical nomenclature, to capitalize all specific epithets derived from proper names, such as names of persons, places, mythological characters and genera. Zoologists rather early abandoned this custom. Later, botanists modified the Recommendation governing this matter and recognized the right of an author to capitalize or not as he desired. In bacteriology, as in zoology, the recommendation is that specific epithets begin with a lower case letter no matter what the origin. This recommendation has some practical significance. Many abstracting journals and many publications in biology must use in a single article the scientific names of bacteria, of plants and of animals. To have different regulations for the capitalization of specific epithets would be confusing. However, if an author chooses to capitalize a specific epithet, the species name is accepted, though those who use the word subsequently may use a lower case initial letter.

RECOMMENDATION 27i. Names of taxa and specific epithets are often compound words, sometimes formed from Latin stems, more often from Greek stems, sometimes (less correctly) from stems from two different languages. Such compound words formed from the same stems may differ only in the connecting vowels.

- (a) In the formation of compound names of taxa and of specific epithets from the Latin, the preferred connecting vowel is *-i-*. Such compound names differing in spelling only by having the connecting vowel *-i-* or *-o-* are to be regarded as orthographic variants. Names of taxa which are such orthographic variants and based upon different types are to be regarded as homonyms. The spelling used for the name of each taxon or for each specific epithet should be that used by the author when the compound was validly published.
- (b) The combining vowel in Greek compounds in which the first component is a noun (substantive) or adjective is usually *-o-*. It may be omitted if the second component begins with a vowel or when the first component ends in *y*, e.g. *glycychylus*. Another combining vowel may be used if there is good Greek precedent, e.g., as in *Corynebacterium*. Names of taxa or words used as specific epithets which are Greek compounds and differ only in the presence or absence of the combining vowel *-o-*, or have another combining vowel, are to be regarded as orthographic variants. If the names are based upon different types they are to be regarded as homonyms. The correct spelling is that used by the author of the name in its initial and valid publication.
- (c) Compound words derived from two or more languages (nomina hybrida) are to be regarded as orthographic variants if they differ only in the combining vowel. If two compounds which are names of taxa have different nomenclatural types they are to be regarded as homonyms. The spelling first used by an author in the valid publication of a name should govern.

ANNOTATIONS

Recommendation 27i (a). The Latins, in contrast to the Greeks, rarely joined stems to form new words. When stems were so joined, the connecting vowel was usually *-i-*, as in *atricapillus* (black haired), *albicomus* (white haired), *aquifolius* (with pointed leaf), in modern Latin *moniliformis* (in form of a necklace). New words were more commonly formed by use of numerous prefixes and suffixes.

In the modern Latin of biology there are numerous instances in which the connecting vowel between Latin stems is *-o-*. This is particularly true of words in which the first component has to do with color. The Latins occasionally coined such words as *albogilvus* (whitish yellow) in which both components are adjectives, the first component of the compound having an adverbial connotation

(whitish). This precedent has been followed in bacteriology in numerous compound specific epithets, as witnessed by *albidoflavus*, *albogilvus*, *alboniger*, *albosporeus*, *atrofaciens*, *aurogenus*, *nigromaculans*, *flavogriseus*, *flavovirens*, *griseoflavus*, *griseoluteus*, *roseoflavus*, *rubropertinctus*.

Recommendation 27i (b). The Greeks formed many compound words. In consequence, Greek stems have been much used in making compounds for use as generic names throughout biology. Most Greek compounds with stems from adjectives and nouns show *-o-* as the connecting vowel. Greek precedent for *Corynebacterium* is found in Greek compounds such as *corynephorus* (club-bearing). A modern specific epithet is *halmeophilus* (brine-loving). Examples of use of *-o-* are to be found in many generic names, as *Achromobacter*, *Actinomyces*, *Blastocaulis*, and in specific epithets as *achromogenes*, *lipophagus*, *leptotrichoides*.

Recommendation 27i (c). The recommendations advising against the formation of compound names or epithets from words of two or more languages, particularly Latin and Greek, have been frequently ignored. Since such names in their formation do not violate a rule, they may be legitimate. There are many such words in bacteriology; some are Latin-Greek, some Greek-Latin, some have *-i-* as the combining vowel, some have *-o-* and some have another vowel.

Latin-Greek, with connecting vowel *-o-*: *Acetobacter*, *acidophilus*, *albosporeus*, *flavochromogenes*, *Lactococcus*.

Latin-Greek with connecting vowel *-i-*: *Brevibacterium*, *Ramibacterium*.

Greek-Latin with connecting vowel *-o-*: *Actinobacillus*, *thermofuscus* (sic).

Greek-Latin with connecting vowel *-i-*: *bacteriferus*, *cristalliferus*.

Latin-Greek with connecting vowel neither *-o-* nor *-i-*: *Catenabacterium*.

Greek-Latin with connecting vowel neither *-o-* nor *-i-*: *gonidiaformans*.

RECOMMENDATION 27j. Authors should give the etymology of new generic names and also of new epithets when the meaning of these is not obvious.

RECOMMENDATION 27k. When it is necessary to choose between words which have been validly published as names of taxa or as specific epithets and which differ in spelling only because of faulty or alternative spelling of Latin words, or because of faulty or alternative transliterations of Greek to Latin, or because of alternative transfer of endings denoting gender or the oblique cases, (particularly the genitive) from Greek to Latin, it is recommended that choices be governed by the provisions of Appendix B to this Code.

ANNOTATIONS

Recommendation 27j. Compliance with this recommendation might well tend to reduce the number of nonsense words in bacteriological nomenclature, particularly nonsense specific epithets, in species names such as *Bacillus albolactis* (meaning the *Bacillus* of white milk instead of the intended white *Bacillus* of milk), or *Bacillus thermodiastaticus* (meaning the "thermally diastatic *Bacillus*," the intended meaning probably being the "thermophilic and diastatic *Bacillus*"). The student is surprised to find that *Streptomyces novaecaesariae* means the "*Streptomyces* of New Jersey," that *noveboracensis* refers to "New York," *cantabrigensis* to Cambridge and *Hafnia* to Copenhagen.

Possibly formation of hybrid names (*nomina hybrida*) such as *Brevibacterium*, *Acetobacter* and *Sarcinococcus* would be less frequent if the authors clearly stated that the hybrid word contravened a nomenclatural recommendation.

RECOMMENDATION 27l. Words transliterated and Latinized from languages that do not use the Latin alphabet are to be regarded as orthographic variants if they differ only in the transliteration. Such orthographic variants used as names of taxa based upon different types are to be regarded as homonyms.

RECOMMENDATION 27m. Names of taxa and specific epithets differing only in the presence or suppression of diacritical marks, transliteration of the German umlaut or the use of special letters are to be regarded as orthographic variants; when based upon different types, they should be treated as homonyms. Words not formed in conformity with Rule 27 Note 9 may be corrected.

ANNOTATIONS

Recommendation 27l. Several different systems of transliterating Slavic words have been used by German, French, English and other authors. Different transliterations into the Roman alphabet have given Metschnikoff, Metchnikov, Metschnikow, all from a Russian proper name. Specific epithets derived from these varied spellings are to be regarded as orthographic variants if the differences are in transliteration only.

The accepted specific epithet *lysodeikticus* would be more correctly Latinized from the Greek as *lysodicticus*. The two transliterations would be regarded as orthographic variants of the same word.

RECOMMENDATION 27n. A name or an epithet derived from a non-Latin or a non-Greek word which does not have an ending conforming to one of the Latin declensions and which has not been latinized by the addition of a Latin ending shall be regarded as a non-declinable Latin noun. Two or more names or specific epithets derived from the same word, one with a Latin ending, the other not, are orthographic variants, and when the names of taxa are based on different types they should be treated as homonyms.

RECOMMENDATION 27o. Authors of new names of taxa or of specific or subspecific epithets derived from the Greek are urged to transliterate words or stems into Latin form by adherence to the recommendations of Appendix A.

ANNOTATIONS

Recommendation 27n. Most of the very numerous serotypes of species of the genus *Salmonella* have been named by using the unaltered name of the place of origin (town, city, district) as an epithet with the name of the genus. In some cases the resultant binomial is used as the name of the species. The specific epithet in *Salmonella london* is to be regarded as a nondeclinable modern Latin word. There is good Latin precedent for acceptance of such words. One finds many such words taken over, for example, from the Hebrew in the *Biblia Latina Vulgata*.

RECOMMENDATION 27p. The name of a genus should be spelled without abbreviation the first time it is used with a specific epithet in a publication, (e.g., *Serratia marcescens*) except that in a series of names of species of the same genus it is customary to abbreviate the name of the genus in all names of the species after the first. Later use of the name of a species previously cited usually has the name of the genus abbreviated. The abbreviation used for the name of a genus in a species name is usually the first letter of the generic name (e.g., *S. marcescens*). In publications in which species are listed belonging to two or more genera which have the same initial letter, care should be used to abbreviate the names of the genera so as to avoid confusion.

ANNOTATION

Recommendation 27p. The use of the first letter of the name of a genus as an abbreviation of the name is common practice in biology. However, some authors seek to avoid confusion when discussing two or more genera having the same initial letter by using a longer and more distinctive abbreviation for each. One finds the generic name *Shigella* abbreviated as *S.*, *Sh.*, and *Shig.*; *Salmonella* as *S.*, *Sal.*, and *Salm.*; and *Streptococcus* as *S.*, *Str.*, and *Strep.* Suggestions have been made that a standard list of abbreviations should be developed and adopted. No such list has received any formal approval. There would arise many difficulties in its formulation. More than twenty generic names have been proposed in bacteriology which have *Thio* as a first component. Even abbreviations as long the following are not distinctive. *Achrom.*, *Actino.*, *Aero.*, *Arthro.*, *Azoto.*, *Bact.*, *Caryo.*, *Cell.*, *Chloro.*, *Chrom.*, *Haemo.*, *Halo.*, *Lacto.*, *Lepto.*, *Leuco.*, *Methano.*, *Micr.*, *Myco.*, *Myxo.*, *Nitro.*, *Nitroso.*, *Oscill.*, *Para.*, *Past.*, *Pelo.*, *Pro.*, *Rh.*, *Rhab.*, *Rhodo.*, *Ricketts.*, *Saccharo.*, *Sapr.*, *Sarcin.*, *Sider.*, *Sphaer.*, *Spir.*, *Sporo.*, *St.*, *Str.*, *Strepto.*, *Sulfo.*, *Thermo.*, *Thio.*, *Uro.*, and *Zymo.* No proposed or recommended list of such abbreviations has been widely publicized.

RULE 28. The gender of generic names is governed by the following regulations:

- (a) A Greek or Latin word adopted as a generic name retains its classical gender. In cases where the classical gender varies, the author has the right of choice between the alternative genders. In doubtful cases general usage should be followed.
- (b) Generic and subgeneric names which are modern compounds formed from two or more Greek or Latin words take the gender of the last. If the ending is altered, the gender is that of the new ending in the language of origin.
- (c) Arbitrarily formed generic names or vernacular names used as generic names take the gender assigned to them by their authors. Where the original author has failed to indicate the gender, the next subsequent author has the right of choice.

ANNOTATIONS

Latin words used as generic names are relatively rare. Latin compounds are not abundant. The most common generic names are Greek compounds; many others are derived from personal names.

Rule 28 (a). *Bacillus*, a staff or rod (masculine) and *Sarcina*, a packet (feminine) are examples of Latin nouns used without change as generic names. *Vibrio*, that which vibrates, is derived from the Latin and is feminine.

Latinized Greek nouns used as generic names are *Bacterium*, small rod or staff, and *Clostridium*, a small spindle, both neuter.

Rule 28 (b). A few generic names are compounded from Latin words, as *Lactobacillus*, milk rodlet (masculine), and some hybrid Greek-Latin as *Thiobacillus*, sulfur rod (masculine), and *Thiosarcina*, sulfur packet (feminine).

Throughout biology, including bacteriology, generic names are commonly Latinized Greek compounds. Examples:

Masculine: *Azotobacter* nitrogen rod, *Actinomyces* ray fungus, *Arthrobacter* jointed rod, *Haemophilus* blood lover.

Feminine: *Pseudomonas* false monad, *Crenothrix* spring (fountain) hair, *Spirochaeta* spiral thread, *Zoogloea* animal glue.

Neuter: *Chromobacterium* colored rodlet, *Mycoderma* fungus skin, *Polyangium* many vessels, *Rhizobium* root dweller, *Rhodospirillum* red spiral, *Treponema* turning thread.

A few generic names of bacteria do not conform to Recommendation 5a (4). They are adjectival in derivation and form. In some of these cases the gender is not indicated by the nominative ending, e.g., in *Alcaligenes* and *Bacteroides*. Custom has fixed these as masculine.

The gender of compound generic names having *-bacter* as the final component is fixed as masculine by Opinion 3 of the Judicial Commission (see Appendix C). A request for an Opinion was based upon the fact that some authors regarded such names as neuter (perhaps as a result of confusion with generic names ending in *-bacterium*), others considered them to be masculine.

Rule 28 (c). Most Latin names of plants are feminine. This precedent led to the Recommendation both in bacteriology and botany that new names of genera derived from the names of persons should be put into feminine form. While the Zoological Code indicates equal acceptability for generic names of words from personal names with endings indicating any one of the three genders, nevertheless in most cases generic names in zoology thus derived have been given a feminine ending. In bacteriology most generic names of this type are formed regularly either from personal names, as in *Escherichia*, or by addition of a feminine diminutive as in *Pasteurella*. Even names not regularly formed, as *Ricoclesia* usually indicate their gender by the ending.

CHAPTER 4

Provisions for Exceptions to the Rules and for the Interpretation and Modification of Rules

Provisions for Exceptions to the Rules and for the Interpretation and Modification of Rules

PROVISION 1

Modification and amendment of Code. This Code can be amended only by action of the International Committee on Bacteriological Nomenclature and approval of a plenary session of an International Congress for Microbiology convened by the International Association of Microbiological Societies.

PROVISION 2

Lists of nomina conservanda. To avoid disadvantageous changes in the nomenclature of the genera by the strict application of the Rules of Nomenclature, the Rules provide for a list of names which must be retained as exceptions (*nomina conservanda*).

Note 1. This list of conserved names will remain permanently open for additions. Any proposal of an additional name must be accompanied by a detailed statement of the case for and against its conservation. Such proposals must be submitted to the Judicial Commission (see Provision 4) for study and appropriate action.

Note 2. When a name proposed for conservation has been provisionally approved by the Judicial Commission, bacteriologists are authorized to retain it pending the decision of the next International Congress for Microbiology.

Note 3. A conserved name is conserved against all other names for the taxon, whether these are cited in the corresponding list of rejected names or not, so long as the taxon concerned is not united with another taxon bearing a legitimate name. In the event of union or reunion with another taxon, the earlier of the two competing names is adopted in accordance with Rules 19, 20 and 21.

Note 4. A conserved name is conserved against all earlier homonyms.

* No annotations are included in Chapter 4; the entire chapter is a part of the official Code.

PROVISION 3

Lists of nomina rejicienda. To avoid unnecessary confusion in the nomenclature of bacteria by the strict application of the rules of nomenclature, the Rules provide a list of names (*nomina rejicienda*) which are not to be used, i.e., are to be permanently rejected. This list includes names which, owing to segregation, are used with different meanings and have become a permanent source of confusion or error (*nomina ambigua*), names where application is uncertain (*nomina dubia*), and names applied to a group made up of two or more discordant elements, especially if these elements were erroneously supposed to form part of the same individual (*nomina confusa*).

Note 1. This list of rejected names will remain permanently open for additions. Any proposal of an additional name must be accompanied by a detailed statement of the case for and against its rejection. Such proposals must be submitted to the Judicial Commission of the Nomenclature Committee for study and appropriate action. When a name proposed for rejection has been provisionally rejected by the Judicial Commission, bacteriologists are authorized to reject it pending the decision of the next International Congress for Microbiology.

Note 2. A rejected name may not be later introduced legitimately into bacteriological literature, except that *nomina dubia* may be removed from the list upon submission of evidence of correct status and by action by the Judicial Commission.

PROVISION 4

Permanent International Committee on Bacteriological Nomenclature. A Permanent International Committee on Bacteriological Nomenclature has been established by the International Association of Microbiological Societies in Congress. This Committee is so constituted that wherever practicable each country is represented by at least one member and no country by more than five. Nominations for membership are made preferably by one or more of the microbiological societies in each country. If nominations are not made by the microbiological societies of a country, nominations may be made by members of the Nomenclature Committee. Nominations should be made in writing to one of the Permanent Secretaries of the Committee. Acceptance will be indicated by the Secretaries, and the nominees given temporary membership in the Committee pending action of the Committee and of the next International Congress, when the election will be confirmed.

The several societies and Committee members making nominations are urged to nominate persons representing all branches of

microbiology, so that the International Committee on Bacteriological Nomenclature may have broad representation of all microbiological interests in nomenclature. The International Committee on Bacteriological Nomenclature through its Permanent Secretaries shall submit a list of its members to the last Plenary Session of each International Congress for confirmation.

At least one year before each Congress, each national society shall inform the Permanent Secretaries of any recommendations relative to changes in its representation.

Recognition of Alternates. If a member of the International Committee on Bacteriological Nomenclature cannot attend the meetings of the Committee, an alternate having all of the rights of an appointed member, except in the election of officers and commissioners, will be chosen in accordance with the following provisions:

- (a) The national microbiological society which the member represents shall have the right to nominate an alternate.
- (b) If no nomination is made by the national society, the member himself shall have the right to nominate an alternate.
- (c) If neither the national society nor the member nominates an alternate, the Chairman of the Committee with the Permanent Secretaries may nominate.

All nominations for alternates by national societies, or by members shall be in writing and should be in the hands of one of the Permanent secretaries before the first meeting of the Committee.

All nominations for alternates shall be presented at the first meeting of the Committee, and nominees elected by vote of the Committee will serve as alternates.

Functions of the International Committee. The International Committee on Bacteriological Nomenclature has the following functions:

- (1) To hold meetings at the time of and as a part of the sessions of each Congress of the International Association of Microbiological Societies.
- (2) To consider and pass upon all recommendations made by the Judicial Commission relative to the formulation, the modification or the amendment of the International Code of Nomenclature of Bacteria and Viruses, or relating to the nomenclature of other groups of microbiological concern. In cases in which the approval of the Congress is also necessary the Committee will make the appropriate recommendations. Proposals for amendment of the Bacteriological Code shall be submitted to one of the Permanent Secretaries at least one year before the next International Congress.
- (3) To consider all Opinions issued by the Judicial Commission. Such Opinions become final unless rejected by majority vote at the meeting of the Committee next following the date on

which the Opinion was published or submitted to the Committee.

- (4) To authorize or appoint special subcommittees of experts to consider and report on the classification of special groups of microorganisms and other phases of their taxonomy, to sponsor one or more sessions of a Section on Taxonomy and Classification at each International Congress at which these reports of subcommittees may be presented and discussed; to receive and recommend for publication the reports of these subcommittees, and to refer to the Judicial Commission any special problems that have been raised or recommendations that have been made respecting nomenclature.
- (5) To elect from the membership of the Committee the members of the Judicial Commission as vacancies may occur and to replace the members of the several classes as their terms expire.
- (6) Whenever a vacancy occurs, to nominate a Permanent Secretary to the next Plenary Session.
- (7) To appoint as Life Members of the International Committee on Bacteriological Nomenclature individuals who have rendered distinguished service to bacteriological nomenclature and taxonomy. Such Life Members shall be regarded as members-at-large and not as representing the microbiologists of any nation.

Election of Chairman and Vice-chairman. At a meeting held at each International Congress, the Committee shall elect a Chairman and a Vice-Chairman, who shall hold office until the close of the next succeeding Congress.

A. The Duties of the Chairman of the Committee shall be:

- (1) To preside at all meetings of the Committee.
- (2) To collaborate with the Permanent Secretaries in the preparation of the Agenda for the meetings of the Committee.
- (3) To appoint members of such subcommittees as may be approved by the Committee and not otherwise provided for.
- (4) To assume such other duties as may be requested by the Committee.

B. The Duties of the Vice-Chairman of the Committee shall be:

- (1) To preside at the meetings of the Committee in the absence of the Chairman.
- (2) To assume such other duties as may be requested by the Committee.

Election of Two Permanent Secretaries. Two Permanent Secretaries are chosen by the Committee and confirmed by the Plenary

Provision 4 cont.

Session of the Congress. One of the Permanent Secretaries shall primarily represent the interests of medical and veterinary bacteriology and one the interests of non-medical bacteriology. Vacancies in the position of Permanent Secretary which may occur in the interim between Congresses of the International Association of Microbiological Societies shall be filled by the Judicial Commission, such appointments to be temporary unless confirmed by the next Congress. The Permanent Secretaries shall be regarded as members-at-large and shall not be included in the quota of any nation.

The duties of the Permanent Secretaries shall be:

- (1) To prepare, in cooperation with the Chairman of the Committee, the Agenda for all meetings of the Committee.
- (2) To serve exofficio as voting members and as joint Secretaries of the Judicial Commission.
- (3) To secure from the several national societies representing microbiology their nominations for membership, and when such nominations are in accordance with the Provisions of this Code of Nomenclature, to certify such nominees to temporary membership, and to prepare a list of all nominations for membership for presentation to the Committee at its first regular meeting at each International Congress.
- (4) To receive from the Judicial Commission such recommendations as may require action by the Committee; in the intervals between International Congresses to duplicate and send such recommendations to all members of the Committee. If the members of the Committee are circularized to secure comments and suggestions, to tabulate the information received. If the members are asked to vote upon any proposal, to tabulate and announce the result of the ballot and to certify the results to the Chairman of the Committee and to the Chairman of the Commission.
- (5) With the Chairman of the Judicial Commission, to serve as members of the Editorial Board to edit and prepare for final publication all Opinions issued by the Judicial Commission, also the International Code of Nomenclature of the Bacteria and Viruses and its amendments, and all other publications authorized by or sponsored by the Committee or by the Judicial Commission.

- (6) To keep the minutes of the Committee and of the Judicial Commission and submit them for publication in the Proceedings of the appropriate International Congress and in the *International Bulletin of Bacteriological Nomenclature and Taxonomy*.
- (7) To present to the Plenary Session of the Congress all actions of the Judicial Commission or the International Committee requiring approval of said session.
- (8) One or the other of the Permanent Secretaries shall be designated a member of each subcommittee authorized or appointed by the International Committee, and shall be responsible only for advising the specialist subcommittees on the interpretation of the International Code of Nomenclature of the Bacteria and Viruses.
- (9) With the Chairman to authorize the formation of new subcommittees to consider the taxonomy and classification of special groups of microorganisms, such subcommittees to have provisional status only until such time as they may be duly authorized by action of the International Committee on Bacteriological Nomenclature. Proposals for the formation of such subcommittees may be made by an individual or by a group of individuals to one of the Permanent Secretaries. Such a request should be accompanied by a statement of the proposed duties of the subcommittee and a list of the members proposed.

Functions of Taxonomic Subcommittees. Taxonomic subcommittees of experts authorized and appointed by the International Committee on Bacteriological Nomenclature shall work under the following rules:

- (1) The chairman and secretary shall be elected by members of the subcommittee and shall hold office for six years. After holding office they shall be eligible for re-election.
- (2) Ordinary members of the subcommittee shall be appointed by the International Committee. Between Congresses, the chairman and secretary, acting in agreement, may co-opt as temporary members specialists who can contribute substantially to the work of the subcommittee. At the next Congress the names of temporary members shall be submitted to the International Committee, which shall determine whether they shall become ordinary members.
- (3) One of the Secretaries of the International Committee shall be an *ex officio* member of each subcommittee, but shall not have voting powers.
- (4) Each subcommittee shall meet at each International Congress and shall review its membership. The names of members who have retired or have ceased to interest themselves in the work of the subcommittee, or who have died, shall be deleted from the membership list. The subcommittee shall, if it desires, replace the inactive members by more active experts, but it is not essential to maintain the membership at a definite number.

- (5) The chairman and secretary of each subcommittee will be jointly responsible for the presentation of a report to the International Committee. This report, if approved by the International Committee, will be published in the *International Bulletin of Bacteriological Nomenclature and Taxonomy*. The report should be accompanied by an up-to-date list of names and addresses of members of the subcommittee.
- (6) A subcommittee may create one or more subgroups to study particular problems. Each subgroup shall have a chairman appointed by the subcommittee. At least two-thirds of the members of each subgroup shall be appointed by the subcommittee, but need not themselves be members of the subcommittee; up to one-third may be co-opted as experts, at the invitation of the subgroup's chairman.
- (7) When votes are called for in subcommittees or subgroups, a simple majority shall suffice; in the event of a tie, the chairman shall have a second or casting vote. If members wish to record a unanimous decision, a fresh vote may be called for. Votes shall be recorded by a show of hands unless a secret ballot is demanded by at least one-quarter of the members present.
- (8) Members who cannot attend meetings of subcommittees may send alternates to act for them. An alternate should be provided by the member with a written authority which will entitle him to record a vote on the members behalf. Expert observers may be introduced by members, but do not have voting rights.
- (9) Between Congresses, the work of the subcommittees will be conducted by correspondence; when votes are called for, each ballot paper will be signed by the member; unsigned papers will not be counted.

PROVISION 5

Authorization of a Judicial Commission. A Judicial Commission is authorized; it shall consist of fourteen members, twelve elected by the members of the International Committee on Bacteriological Nomenclature from its membership and the two Permanent Secretaries. The Commissioners are elected to serve in three classes of four Commissioners each, one class retiring at the close of the meeting of each International Congress of the International Association of Microbiological Societies. In case of the resignation or death of a Commissioner during the interval between Congresses, the vacancy may be filled by letter ballot of the members of the International Committee.

If a Commissioner cannot attend the meetings of the Judicial Commission, an alternate having all the rights of a Commissioner except in the election of officers will be chosen in accordance with the following provisions:

- (a) The Commissioner himself shall have the right to nominate an alternate.
- (b) If no nomination is made by the Commissioner, the Judicial Commission will elect an alternate from members of the Committee on Bacteriological Nomenclature attending the Congress.

All nominations shall be in writing and in the hands of the Chairman of the Judicial Commission before the first meeting of the Commission. All nominations for alternates shall be presented at the first meeting of the Commission and nominees elected by vote of the Commission will serve as alternates.

One of the Commissioners shall be chosen as Chairman and one as Vice-chairman by vote of the Judicial Commission. The Chairman and Vice-chairman shall hold office during their unexpired terms as Commissioners.

Duties of the Chairman of the Judicial Commission. The Chairman of the Judicial Commission shall have the following duties:

- (1) To preside at meetings of the Judicial Commission.
- (2) To prepare, with the collaboration of the Permanent Secretaries of the Committee, the Agenda for meetings of the Judicial Commission.
- (3) To appoint such committees as are authorized by the Judicial Commission but whose appointment has not been otherwise provided for.
- (4) To serve as Chairman of the Editorial Board with the two Permanent Secretaries. This Editorial Board is charged with the responsibility of editing and arranging for the publication of the Opinions issued by the Judicial Commission, the International Code of Nomenclature of Bacteria and Viruses with amendments, and all other publications

Provision 5 cont.

issued or sponsored by the Judicial Commission or the International Committee on Bacteriological Nomenclature.

- (5) With the cooperation of the Permanent Secretaries, to formulate tentative Opinions and proposals either for discussion or for vote by the members of the Judicial Commission, and to receive and codify or tabulate the results.
- (6) To maintain a list of all requests for Opinions or for assistance in nomenclatural problems which come to the Commission and to expedite the formulation and publication of Opinions of the Judicial Commission.
- (7) With the cooperation of the Permanent Secretaries to put in form for consideration requests or suggestions for emendation of the International Bacteriological Code of Nomenclature of the Bacteria and Viruses, to circulate such requests or formulations to the Commissioners, to call for votes, to tabulate them and to make the appropriate recommendations to the International Committee on Bacteriological Nomenclature.
- (8) To transmit, through the Permanent Secretaries, to the International Committee the Opinions as issued by the Judicial Commission, and all recommendations and actions of the Judicial Commission requiring the consideration or the approval of the International Committee.
- (9) To represent the Judicial Commission on such International Committees, Boards or Commissions as may be organized to consider cooperation in biology in the solution of common problems of nomenclature and taxonomy, particularly to work with other similar Commissions or Executive Committees organized for action on problems on nomenclature in botany and in zoology.
- (10) To undertake such other duties as may from time to time be requested by the Judicial Commission.

Functions of the Judicial Commission. The Judicial Commission has the following functions:

- (1) To hold such regular sessions as may be necessary for the transaction of all business which should come before it at the time of the sessions of each Congress of the International Association of Microbiological Societies.
- (2) To consider all requests for Opinions relative to the interpretation of the Principles, Rules, Recommendations and Provisions of the International Code of Nomenclature of the Bacteria and Viruses where applications are doubtful. A request for an Opinion should be accompanied by a fully

documented statement of the relevant facts; when a request is not supported by adequate evidence it shall be returned to the author for revision. When an Opinion is challenged the basis of the challenge shall be stated and supported by a documented statement of the relevant facts.

In suitable cases an Opinion shall be prepared which, if approved by eight or more Commissioners, shall be issued and published, becoming thereby available for the guidance of bacteriologists. All Opinions are reported to the International Committee on Bacteriological Nomenclature and, unless rescinded by majority vote of this Committee, such Opinions become final.

- (3) To consider each proposal for amendment of the International Bacteriological Code of Nomenclature and to formulate a recommendation for such amendment. When approved by eight or more Commissioners, it shall be submitted to the members of the International Committee on Bacteriological Nomenclature and shall be considered as tentatively approved when it has been accepted by seventy per cent of the members voting. It shall be submitted for final approval to the next Plenary Session of an International Congress.
- (4) To exercise the plenary powers conferred upon the Commission by the International Bacteriological Code of Nomenclature and by the Fourth Congress of the International Association of Microbiologists to suspend the rules as applied to any given case, where, in its judgment, the strict application of the Rules will clearly result in greater confusion than uniformity. If the suspension of the rules is by unanimous vote of the Commissioners, the decision is final, except that an appeal may be taken to the International Committee on Bacteriological Nomenclature, which may rescind the action by majority vote of those voting. If the suspension of the rules is initially approved by nine or more Commissioners, but the vote is not unanimous, the resolution for suspension shall be submitted to the members of the International Committee on Bacteriological Nomenclature and will be validated by an affirmative vote of seventy per cent of those voting.
- (5) To establish lists of the names of taxonomic groups (taxa) that are to be conserved (*nomina conservanda*) on the basis of Opinions issued relative to the status of such names. There shall be included a list of conserved generic names (*nomina generica conservanda*) together with a list of the

generic names against which each name is conserved (*nomina generica rejicienda*), also a list of conserved specific epithets (*epitheta specifica conservanda*), together with a list of the specific epithets against which they are conserved (*epitheta specifica rejicienda*), also a list of conserved names of taxonomic groups (taxa) of higher ranks than the genus (*nomina conservanda ordinum, familiarum, etc.*).

- (6) To prepare and publish lists of types which have been fixed through issuance of Opinions of the Judicial Commission. These may include lists of type specimens, cultures, etc. for species or subdivisions of species, type species for genera, type genera for higher taxonomic groups (taxa). Type cultures of species and subdivisions of species may be designated by the number of the strain or other symbol under which they are carried in the type culture collection.
- (7) To prepare and publish lists of names of genera of bacteria that have been validly published and, if found advisable, lists of the generic names of other groups in which microbiologists are interested. Such lists would be designed to assist authors publishing new names and combinations to avoid proposing illegitimate later homonyms.
- (8) To prepare and publish a list of publications in the field of bacteriology in which names proposed shall be regarded as not validly published and having no standing in bacteriological nomenclature.
- (9) To report to the International Committee on Bacteriological Nomenclature at its first meeting at each International Congress the names of all Commissioners whose terms of service expire at the close of the Congress and a list of other vacancies in the membership of the Commission, all of which should be filled by election by the Committee.
- (10) To prepare Opinions, when requested, relative to the nomenclatural status of microorganisms studied by microbiological techniques, but not classed with the bacteria or the viruses, as for example, the yeasts, molds, algae and protozoa. However, Opinions shall not be issued with reference to organisms in these groups until they have been approved by the Commission or Executive Committee charged with the interpretation of the appropriate code of nomenclature (zoological or botanical).
- (11) Through its Chairman and with the collaboration of the Permanent Secretaries to cooperate with other Commissions or similar bodies appointed by the International Botanical and Zoological Congresses to consider problems of nomenclature.

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- (12) Upon approval of the International Committee, to establish such Trusts or enter into such agreements as may be advisable for the auditing and administration of funds which may be designated for the payment of the necessary operating expenses of the Judicial Commission and Committee, whether such funds originate from grants-in-aid, gifts, royalties, or moneys received from the sale of publications or from other sources.
 - (13) To request from appropriate international agencies of the United Nations, or from other organizations or foundations, grants-in-aid for the payment of the necessary expenses of the work of the Judicial Commission and of the Committee.
 - (14) To sponsor or establish such publications, bulletins, or journals, as may be found necessary adequately to present requests for Opinions from the Judicial Commission, to present discussions of these requests, and to give the steps from the inception of the study to the final Opinion, suspension of a rule or allocation to lists of *nomina conservanda* or of *nomina rejicienda*.

APPENDIX A

*Transliteration of Greek Words for Use
in Nomenclature in Bacteriology*

Transliteration of Greek Words for Use in Nomenclature in Bacteriology

Authors desiring to use Greek words in the formation of epithets and names to be introduced into bacteriological nomenclature are advised to transliterate such words into Latin form in conformity with recognized usage as follows:

Greek Α, α (alpha) Latin A, a

ἀκτίς ἀκτῖνος - *actis, actinis*

Actinomyces

The Greek α is the first letter of two diphthongs.

αι - *ae*. αἷμα, αἱματος - *haema, haematis*.

haematoides

Rarely and less correctly transliterated as *ai* as in σφαῖρα - *sphaira*, whence *Sphaira*, a protozoan generic name. Occasionally αι does not constitute a diphthong, as in αἴστωρ - *aistor* and is then transliterated *ai*. Not infrequently αι has been incorrectly transliterated as *e*, as in *Hemophilus*.

αυ - *au* αὔξω - *auxo*

auxinophilus

ἅ αι - *ha* and *hae*, respectively, as in ἅλς, ἅλός - *hals, halis*

halophilus

αἷμα - *haema*

Haemophilus

Greek Β, β (beta) Latin B, b

βακτήριον - *bacterium*

Bacterium

Greek Γ, γ (gamma) Latin G, g

γάλα γάλακτος - *gala, galactis*

Galactococcus

When γ precedes γ, κ, ξ, χ, it is transliterated as *n*.

γγ - *ng* ἀγγεῖον - *angium*

Archangium

γκ - *nc* ἐγκέφαλος - *encephalus*

encephaloides

γξ - *nx* σφίγξ - *sphinx*

Sphinx

γχ - *nch* σύγχυσις - *synchysis*

synchyseus

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| διπλοῦς - <i>diplos</i> | Greek Δ, δ (delta) Latin <i>D, d</i> | <i>Diplococcus</i> |
| ἔντερον - <i>enterum</i> | Greek Ε, ε (epsilon) Latin <i>E, e</i> | <i>Enterococcus</i> |
| The Greek ε is the first letter of two Greek diphthongs. ει - <i>i</i> , θεῖον - <i>thium</i> | | <i>Thioploca</i> |
| More rarely ει - <i>e</i> as ζεῖα - <i>zeae</i> | | <i>zeae</i> |
| εὔ - <i>eu</i> εἶς - <i>eus</i> | | <i>Eubacterium</i> |
| ἥ - <i>he</i> ἥλος - <i>helcus</i> | | <i>helicogenes</i> |
| ζῶον - <i>zoum</i> | Greek Ζ, ζ (zeta) Latin <i>Ζ, z</i> | <i>Zoogloea</i> |
| κήρινος - <i>cerinus</i> | Greek Η, η (eta) Latin <i>E, e</i> | <i>cerinus</i> |
| Greek nouns ending in η are feminine. When transliterated they were placed in the first declension with ending <i>a</i> or <i>e</i> as χαιτή - <i>chaete</i> or <i>chaeta</i> | | <i>Spirochaeta</i> |
| ἥ - <i>he</i> ἥλιος - <i>helius</i> | | <i>helianthi</i> |
| θρίξ - <i>thrix</i> | Greek Θ, θ (theta) Latin <i>Th, th</i> | <i>Erysipelothrix</i> |
| ἰχθύς - <i>ichthys</i> | Greek Ι, ι (iota) Latin <i>I, i</i> | <i>ichthyosmius</i> |
| ἵππος - <i>hippus</i> | | <i>hippopotami</i> |
| κορύνη - <i>coryne</i> | Greek Κ, κ (kappa) Latin <i>C, c</i> | <i>Corynebacterium</i> |
| The Greek κ is sometimes incorrectly transliterated as <i>k</i> , as βακτήριον - <i>bakterium</i> . | | |
| λευκός - <i>leucus</i> | Greek Λ, λ (lambda) Latin <i>L, l</i> | <i>Leuconostoc</i> |
| μικρός - <i>micrus</i> | Greek Μ, μ (mu) Latin <i>M, m</i> | <i>Micrococcus</i> |
| νεκρός - <i>necrus</i> | Greek Ν, ν (nu) Latin <i>N, n</i> | <i>necrophorus</i> |
| μύξα - <i>myxa</i> | Greek Ξ, ξ (xi) Latin <i>X, x</i> | <i>Myxococcus</i> |
| ὄζαινα - <i>ozaena</i> | Greek Ο, ο (omicron) Latin <i>O, o</i> | <i>ozaenae</i> |
| The Greek ο is the first letter of two diphthongs. οι - <i>oe</i> οἶδημα - <i>oedema</i> | | <i>oedematiens</i> |
| ου - <i>ouis</i> - <i>pus</i> | | <i>Rhizopus</i> |
| In the Greek, final -ον is usually the ending of a neuter noun or adjective. Such words were placed in the | | |

Appendix A. Transliteration of Greek

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| second Latin declension, with the ending usually -um, occasionally -on, as in ἀγγεῖον - <i>angium</i> | <i>Archangium</i> |
| περσικόν - <i>persicon</i> | <i>Lycopersicon</i> |
| Final -ος is a masculine nominative ending for nouns and adjectives. Such words were placed in the second Latin declension, with the ending usually -us, occasionally -os, as in φίλος - <i>philus</i> | <i>hydrophilus</i> |
| Final -ος is also found in Greek genitives. Such words were placed in the third Latin declension with the ending usually -is, occasionally -os, as in ἐρυσσιπέλατος - <i>erysipelatis</i> | <i>erysipelatis</i> |
| ὑς, ὕος - <i>hys, hyos</i> | <i>hyos</i> |
| ὅ - <i>ho ὅρμος - hormus</i> | <i>Hormiscium</i> |
| Greek Π, π (pi) Latin P, p | |
| πλάνος - <i>planus</i> | <i>Mycoplana</i> |
| In composition, π followed by a <i>spiritus asper</i> becomes φ - <i>ph</i> . | |
| Greek Ρ, ρ (rho) Latin R, r | |
| σπειρά - <i>spira</i> | <i>Spirochaeta</i> |
| Initial ρ always has the <i>spiritus asper</i> and is transliterated <i>rh</i> , as in ῥόδον - <i>rhodum</i> | <i>rhodochrous</i> |
| In composition, when the second component begins with ρ, and the preceding component ends in a vowel (not a diphthong), the ρ is doubled, and the second ρ retains the <i>spiritus asper</i> . | |
| διάρροια - <i>diarrhoea</i> | <i>diarrhoeae</i> |
| εὐρηκτος - <i>eurectus</i> | <i>eurectus</i> |
| Greek Σ, σ s (sigma) Latin S, s | |
| σφαιρικός - <i>sphaericus</i> | <i>sphaericus</i> |
| Greek Τ, τ (tau) Latin T, t | |
| τέτρα - <i>tetra</i> | <i>tetragenus</i> |
| In composition, τ followed by a vowel having a <i>spiritus asper</i> becomes θ - <i>th</i> . | |
| Greek Υ, υ (upsilon) Latin Y, y | |
| μύκης, μύκητος - <i>myces, mycetis</i> | <i>Schizomycetes</i> |
| The Greek υ is the second letter of three Greek diphthongs. | |
| αυ - <i>au</i> αὔξη - <i>auxe</i> | <i>auxinophilus</i> |
| ἐυ - <i>eu-</i> | <i>Eubacteriales</i> |
| ου - <i>u</i> οὖς - <i>pus</i> | <i>Rhizopus</i> |
| ὕ - <i>hy</i> ὕδρο - <i>hydro-</i> | <i>Hydrogenomonas</i> |

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|---|--|----------------------------------|
| <i>φαγός</i> - <i>phagus</i> | Greek Φ, φ (phi) Latin <i>Ph</i> , <i>ph</i> | <i>Phagus</i> |
| <i>χλαμύς</i> , <i>χλαμύδος</i> - <i>chlamys</i> , <i>chlamydis</i> | Greek Χ, χ (chi) Latin <i>Ch</i> , <i>ch</i> | <i>Chlamydobacte- riales</i> |
| <i>ψευδής</i> - <i>pseudes</i> | Greek Ψ, ψ (psi) Latin <i>Ps</i> , <i>ps</i> | <i>Pseudomonas</i> |
| <i>ὄν</i> - <i>oum</i> | Greek Ω, ω (omega) Latin <i>O</i> , <i>o</i> | <i>Oospora</i> |

APPENDIX B

Alternative Spellings of Names and Epithets in Bacteriology: Orthographic Variants

Alternative Spellings of Names and Epithets in Bacteriology: Orthographic Variants

Alternative spellings (orthographic variants) of names or epithets found in the literature of microbiology frequently have resulted from alternative or faulty spelling of Latin words, from faulty or alternative transliteration of Greek words into Latin form, or from faulty or alternative endings used to indicate gender or case when Greek words are transliterated. Authors of new names of taxa and of epithets are urged to make choices in conformity with the following recommendations:

- (a) Alternative spelling of names and epithets taken from the Latin.
 1. Classic Latin precedent should be followed in the formation of new names of taxa derived from Latin words having alternative spellings involving the two diphthongs *ae* and *oe*. The spelling of names of taxa in which the classic spelling is not observed may be corrected.
 2. In formation of new names of taxa from Latin words spelled classically with an *f* but alternatively with *ph*, the *f* spelling is to be preferred. Names of taxa of Latin derivation spelled by the author with *ph* may be corrected.
- (b) Alternative spelling of names and epithets taken from the Greek.
 1. In the formation of a compound name or specific epithet from a Greek word which increases in the genitive, it is preferable to use the longer stem unless there is good Greek precedent for the use of the alternative stem or combining form; words otherwise similar, derived one from the short and one from the long form, are not to be regarded as orthographic variants. If based upon different types they are not to be regarded as homonyms. However, when the word constitutes the final component of a generic name, the longer stem should be used in the formation of the names of higher taxa; if the shorter stem has been used the spelling should be corrected.
 2. Of two orthographic variants arising from alternative transliterations of $\epsilon\iota$ to *i* or to *e*, the spelling used by the author in the first valid publication should be accepted. If based upon different types they should be regarded as homonyms.
 3. Names of taxa with alternative spellings arising from transliteration of η to *e* or to *a* are to be regarded as orthographic variants. If based upon different types, they are to be treated as homonyms. The preferred spelling is that used in the first valid publication of the name.

4. In the formation of names of taxa and of specific epithets the Greek diphthong *au* should be transliterated as *ae*. Words in which the diphthong *au* is transliterated as *e* are to be regarded as orthographic variants of those correctly transliterated. Orthographic variants based upon different types are to be regarded as homonyms. Names of taxa in which *au* has been improperly transliterated may be corrected.
 5. In a Greek compound in which the second or later component has *ρ* as the initial letter and in which the component is preceded by a vowel (but not a diphthong) the *ρ* should be doubled and transliterated as *rrh*. A transliteration as *r* or *rh* is to be regarded as an orthographic variant, and if the taxa bearing the names are based on different types they should be treated as homonyms. Orthographic variants of this kind may be corrected.
- (c) Alternative spellings of gender and case endings.
1. Epithets and names of taxa with alternative spellings arising from the use in Latin of the endings *-us* and *-os* for transliterated masculine nouns and adjectives which in the Greek end in *-os* are orthographic variants. Similarly, the alternative spellings arising from the use in Latin of the endings *-um* and *-on* for transliterated neuter nouns and adjectives which in the Greek end in *-ov* are orthographic variants. When based upon different types, they should be regarded as homonyms. When used as the name of a taxon the correct spelling is that used by the author in the first valid publication. When used as an adjectival specific epithet, the Latin endings *-us* and *-um* are to be preferred. Specific epithets may be corrected to the preferred spelling.
 2. Greek nouns used as specific epithets in the genitive may have alternative spellings arising from the use in Latin of the endings *-is* and *-os* for transliterated Greek nouns whose genitive case ending in the Greek is *-os*; they are to be regarded as orthographic variants. The preferred spelling is *-is*, and variants may be corrected.

APPENDIX C

*Opinions Relating to Nomenclature
of the Bacteria and Viruses*

Opinions Relating to Nomenclature of the Bacteria and Viruses

Foreword. The first Opinions relating to nomenclature in bacteriology resulted from proposals made to the International Committee on Bacteriological Nomenclature at its meeting in London held during the sessions of the Second International Congress for Microbiology in 1936. The Opinions were approved by the International Committee and by the plenary session of the Congress.

The International Committee at its meeting held in New York in 1939 during the sessions of the Third International Congress for Microbiology, with the concurrence of the Plenary Session of the Congress, selected a Judicial Commission with certain functions, among them:

- (a) To issue formal Opinions when asked to interpret rules of nomenclature in cases in which the application of a rule is doubtful.
- (b) To prepare formal Opinions relative to the status of names which have been proposed, placing such names when deemed necessary in special lists, such as lists of *nomina conservanda*, *nomina rejicienda*, etc. . . .
- (c) To develop recommendations for emendations of the International Rules for Bacteriological Nomenclature for presentation to the International Committee.
- (d) To prepare formal Opinions relative to types, particularly types of species and genera, and to develop a list of bacterial genera which have been proposed with the type species of each.

These functions were somewhat amplified in the International Bacteriological Code of Nomenclature approved at the Fourth International Congress of Microbiology held in Copenhagen in 1947.

The International Committee (1953) at its meeting in Rome during the sessions of the Sixth International Congress of Microbiologists directed that the Opinions voted by this Committee before adoption of the Bacteriological Code should be designated by letters, those issued by the Judicial Commission to be numbered.

OPINIONS ISSUED BY THE INTERNATIONAL COMMITTEE ON BACTERIOLOGICAL NOMENCLATURE IN 1936

OPINION A

Conservation of the generic name *Bacillus* Cohn 1872, designation of the type species, and of the type strain of the species

On the proposals of Prof. R. E. Buchanan and Prof. H. J. Conn relative to the status of the genus *Bacillus* and its type species *Bacillus subtilis*, it was agreed that:

- (a) *Bacillus* Cohn 1872 should be designated as a genus conservandum.
- (b) The type species of *Bacillus* should be designated as *Bacillus subtilis* Cohn 1872 emendavit Prazmowski 1880.
- (c) The type (or standard) strain should be the Marburg strain.
- (d) Cultures of the type (or standard) strain of *Bacillus subtilis* together with complete description should be maintained at each of the recognized Type Culture Collections.
- (e) The genus *Bacillus* should be so defined as to exclude bacterial species which do not produce endospores.
- (f) The term *Bacillus* should be used as a generic name and that it should be differentiated from the terms "bacillus," "bacille" and "Bazillus" used as morphological designations.

OPINION B

Generic homonyms in the group Protista

On the proposal by Prof. F. Mesnil relative to generic homonyms, it was agreed that:

- (a) Generic homonyms are not permitted in the group Protista.
- (b) It is advisable to avoid homonymy amongst Protista on the one hand, plant or animals (Metazoa) on the other.

OPINION C

Capitalization of specific epithets derived from names of persons
Prof. R. S. Breed proposed and it was agreed that:

While specific substantive names derived from names of persons may be written with a capital initial letter, all other specific names are to be written with a small initial letter.

OPINIONS ISSUED BY THE JUDICIAL COMMISSION**OPINION 1**

Spelling of the specific epithet in *Bacillus megaterium* deBary
The spelling megaterium of the specific epithet in *Bacillus megaterium* deBary 1884 is to be preferred to the spelling megatherium.
(Internatl. Bull. Bact. Nomen. and Tax. 1:35-36. 1951)

OPINION 2

Stems (combining forms) of -bacterium, -bactrum, -bactron, and -bacter
The combining form or stem of the last component of names ending in -bacterium is -bacteri, of those ending in -bactrum or -bactron is -bactr, and of those ending in -bacter is -bacter. Family names derived from such generic names have respectively the endings -bacteriaceae, -bactraceae and -bacteraceae.
(Internatl. Bull. Bact. Nomen. and Tax. 1:37-38. 1951)

OPINION 3

Gender of bacterial names that end in -bacter
The names of bacterial genera which end in -bacter should be regarded as having the masculine gender.
(Internatl. Bull. Bact. Nomen. and Tax. 1:84-85. 1951)

OPINION 4 (Revised)

Rejection of generic name *Bacterium* Ehrenberg
The bacterial generic name *Bacterium* Ehrenberg 1828 is to be recognized as a nomen genericum rejiciendum (rejected generic name). The bacterial family name Bacteriaceae is to be recognized as a nomen familiae rejiciendum (rejected family name).
(Internatl. Bull. Bact. Nomen. and Tax. 4:142. 1954)

OPINION 5**Conservation of the Generic Name**

***Pseudomonas* Migula 1894 and Designation of**
Pseudomonas aeruginosa

(Schroeter) Migula 1900 As Type Species

The Editorial Board published a Preliminary Statement (File No. 7) relative to the status of the generic name *Pseudomonas* Migula 1894 and to the designation of the type species. Three proposals were submitted to the members of the Judicial Commission.

The first proposal was approved by twelve Commissioners, it was disapproved by none, and two Commissioners did not vote.

The second proposal was approved by twelve Commissioners, it was disapproved by none, two Commissioners did not vote.

The third proposal was approved by eleven Commissioners, two Commissioners did not vote, and one Commissioner stated that in his

opinion the "selection of type species" is made "in accord with generally accepted rules thus making formal action unnecessary."

The Opinion as approved by the Judicial Commission is as follows:

Opinion 5.

1. **The generic name *Pseudomonas* Migula 1894 is to be conserved and placed in the list of nomina generica conservanda.**
2. **The generic name *Pseudomonas* Migula 1894 is to be associated with the species designated and described by Migula 1895.**
3. **The type species of the genus *Pseudomonas* Migula 1894 is *Pseudomonas aeruginosa* (Schroeter) Migula 1900 *Bacterium aeruginosum* Schroeter 1872, *Bacillus pyocyaneus* Gessard 1882, *Pseudomonas pyocyanea* Migula 1895.**

REFERENCES

- Editorial Board. Status of *Pseudomonas* Migula 1894 as a Generic Name and of *Pseudomonas aeruginosa* (Schroeter) Migula 1900 as Type Species Internatl. Bull. Bact. Nomen. and Tax. 1 (1):41-42. 1951.
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- Schroeter, J. Ueber einige durch Bakterien gebildete Pigmente, in Cohn, F., Beiträge z. Biologie d. Pflanzen. 1 (Heft 2):126. 1872.
- Gessard, C. Sur les Colorations bleue et verte des linges à pansements. C. R. Acad. Sci. Paris. 94:536. 1882.

OPINION 6

Conservation of the Generic Name *Chlorobacterium* Lauterborn 1915 against *Chlorobacterium* Guillebeau 1890

The currently used bacterial generic name *Chlorobacterium* Lauterborn 1915 is a later homonym of *Chlorobacterium* Guillebeau 1890. The latter name has not been used in the literature of bacteriology for more than half a century. A Preliminary Statement (1951) by the Editorial Board outlining the problem was published, likewise a series of suggestions as to alternative actions (1953). At the meeting of the Judicial Commission on September 4, 1953, it was agreed that the existence of the earlier homonym *Chlorobacterium* Guillebeau should not constitute a bar to the use of the later homonym *Chlorobacterium* Lauterborn, and that the name *Cholorobacterium* Guillebeau should be rejected.

Opinion 6.

The generic name *Chlorobacterium* Guillebeau 1890 is placed in the list of nomina generum rejicienda.

REFERENCES

- Editorial Board. *Chlorobacterium* Guillebeau 1890 vs. *Chlorobacterium* Lauterborn 1915, and the status of *Chlorobacteriaceae* Lauterborn 1913. Prelim. State. File No. 8. Internatl. Bull. Bact. Nomen. and Tax. 1 (1): 43-44. 1951.
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OPINION 7

**Nomenclature of the Organism Associated with
Granuloma Venereum**

Bier (1953) outlined the problem of determination of the name to be applied to the organism described by Aragão and Vianna (1913) as associated with and the probable cause of granuloma venereum. The synonymy is confused in the literature. The Judicial Commission, at its meeting of the 5th September, 1953, after a review of the evidence, approved the following Opinion.

Opinion 7.

The bacterial species names *Encapsulatus inguinalis* **Bergey et al. 1923**, *Klebsiella granulomatis* **Bergey et al. 1925**, *Donovania granulomatis* **Anderson, de Monbreun and Goodpasture 1944** are later synonyms of *Calymmatobacterium granulomatis* **Aragão and Vianna 1913**.

REFERENCES

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- Aragão, H. de B., and G. Vianna. Mem. Instituto Oswaldo Cruz. 5:211-238. 1913.
- Bergey, D. H. in Bergey's Manual of Determinative Bacteriology, Williams and Wilkins, Baltimore. 1st Ed. p. 238. 1923. 2nd Ed. p. 264. 1925.
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- Joint Secretaries. Minutes of the Judicial Commission Meetings held in Rome (1953). Internatl. Bull. Bact. Nomen. and Tax. 3 (4):150. 1953.
- Judicial Commission. Opinion 7. *Ibid.* 4 (3-4):144. 1954.

OPINION 8

**The Correct Species Name of the *Streptococcus*
of Bovine Mastitis**

Haupt (1952) proposed that the name of the streptococcus of bovine mastitis be accepted as *Streptococcus agalactiae* Kitt, although the binomial given by Kitt was *Streptococcus agalactiae contagiosae*. Hansen (1953) suggested that Kitt's single specific epithet of two words was changed by Lehmann and Neumann (1896) to a single word, and that the species name *Streptococcus agalactiae* Lehmann and Neumann has become generally recognized and is in common use. A poll of those working with the bovine mastitis streptococci showed general agreement that confusion would best be obviated by conservation of the Lehmann and Neumann species name against all synonyms having priority. The Judicial Commission, in its meeting of 5 September, 1953, approved in principle the conservation of the species name *Streptococcus agalactiae* Lehmann and Neumann, but with instructions to the Editorial Board to discuss certain matters with the proponents of the conservation. It is recognized that the description of the characteristics of the species as given by Lehmann and Neumann are probably inaccurate in some particulars and differ from the descriptions of earlier writers. It is proposed that a type culture or standard culture of *Streptococcus agalactiae* Lehmann and Neumann be selected by a committee of experts, approved, and adequately described, and that the species be based upon this type culture rather than on the Lehmann and Neumann descriptions.

Opinion 8.

The species name *Streptococcus agalactiae* Lehmann and Neumann 1896 is conserved against all synonyms having priority.

REFERENCES

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- Hansen, P. Arne. A note on the name *Streptococcus agalactiae* Lehmann and Neumann. *Ibid.* 3 (1):21-23. 1953.
- Haupt, Herbert. The correct species name of the streptococcus of bovine mastitis. *Ibid.* 2 (3):104-106. 1952.
- Joint Secretaries. Minutes of the Judicial Commission meetings held at Rome in connection with the VI International Congress for Microbiology, Sept. 1953. *Ibid.* 3 (4):150. 1953.
- Kitt, Th. Bakterienkunde und pathologische Mikroskopie für Tierärzte und Studierende der Tiermedizin. 2nd Ed., Vienna, 1893.
- Judicial Commission. Opinion 8. *Ibid.* 4 (3-4):145. 1954.

OPINION 9

Conservation of the Bacterial Generic

Name *Gallionella*

The species name *Gallionella ferruginea* Ehrenberg 1838 was applied by the author to an organism which he erroneously regarded as a diatom, later shown to belong with the bacteria. A Preliminary Statement (1952) by the Editorial Board pointed out that the name *Gallionella* was an altered spelling (probably an attempt at better Latinization of the name Gaillonelle) of the earlier generic name *Gaillonella*. The ascription of an iron bacterium to a genus of diatoms caused Griffith (1853) to propose the new generic name *Didymohelix* for the species *D. ferruginea* (Ehrenberg) Griffith. The generic name *Didymohelix* has not been commonly accepted or used by bacteriologists, the species name *Gallionella ferruginea* has almost universally been used. The name *Gallionella* for a genus of diatoms has quite disappeared in the literature of algology.

The botanist's subcommittee on *Bacillariophyta* (diatoms) proposed that the generic name *Gaillonella* Bory (1823) be placed on the list of botanical *nomina rejicienda*. The reasons for and the implications of this action were ably analyzed by Ross (1952). This rejection also automatically rejects *Gallionella* as a generic name of diatoms. It was suggested that there remained no botanical reason for any "objection to conserving *Gallionella* in the sense of a genus typified by *G. ferruginea* Ehrenberg."

The Judicial Commission at the meeting 5th September 1953, in Rome approved the conservation of *Gallionella* Ehrenberg as a bacterial generic name.

Opinion 9.

***Gallionella* Ehrenberg is placed in the list of conserved names of bacterial genera (nomina generum conservanda) with the type species *Gallionella ferruginea* Ehrenberg.**

REFERENCES

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Griffith, J. W. On *Gallionella ferruginea* (Ehrenberg). Ann. and Mag. Nat. Hist. Ser. 2. 12:438. 1853.
Joint Secretaries. Minutes of the Judicial Commission meetings held at Rome in connection with the VI International Congress for Microbiology, Sept. 1953. Internat. Bull. Bact. Nomen. and Tax. 3 (4):150. 1953.

Ross, R. in Nomenclatural Comments. Conservation of *Gallionella*. *Ibid.* 3 (2, 3):117-119. 1953.

Judicial Commission. Opinion 9. *Ibid.* 4 (3-4):147. 1954.

OPINION 10

Invalidity of the Bacterial Generic Name *Müllerina* de Petschenko 1910 and of the Species Name *Müllerina paramecii*

De Petschenko (1910) published the name *Müllerina* for a genus of bacteria and included one species *M. paramecii*. In this preliminary paper he stated that a more extensive description of the organism would be given later. In a subsequent paper (1911) the names *Drepanospira* and *Drepanospira muelleri* were proposed and used. An Opinion was asked as to the nomenclatural status of these names for the organisms described. A preliminary statement was issued by the Editorial Board (1952). The following Opinion was approved by the Judicial Commission at its meeting on 5th September, 1953.

Opinion 10.

The generic name *Müllerina* de Petschenko 1910 and the species name *Müllerina paramecii* de Petschenko 1910 were not accepted by the author, hence were not validly published and are without standing in nomenclature. The later names *Drepanospira* de Petschenko 1911 and *Drepanospira muelleri* de Petschenko 1911 were validly published and are not later synonyms.

REFERENCES

De Petschenko, Boris. Contributions a l'étude de l'immunité chez les protozoaires. Zentr. f. Bakt. Abt. I. Orig. 56:90-92. 1910.

———. *Drepanospira muelleri* n. g., n. sp. parasite des parameciums; contribution a l'étude de la structure des bactéries. Arch. f. Protistenkunde 22:248-298. 1911.

Editorial Board. The generic names *Müllerina* and *Drepanospira* in bacteriology. Preliminary Statement. File No. 52. Internatl. Bull. Bact. Nomen. and Tax. 2 (1):9-10. 1952.

———. Summary of Opinions and Preliminary Statements. *Ibid.* 3 (2, 3):81. 1953.

Joint Secretaries. Minutes of the Judicial Commission Meetings held in Rome (1953). *Ibid.* 3 (4):150. 1953.

Judicial Commission. Opinion 10. *Ibid.* 4 (3-4):147. 1954.

OPINION 11

Nomenclature of Species in the Bacterial Genus *Shigella*

A request for an Opinion as to the correct names of certain species in the genus *Shigella* was made by Boyd and Cowan (1951). It was supported by the recommendations of the *Shigella* Commission of the Enterobacteriaceae Subcommittee (1951). A Preliminary Statement was published (1951). The Judicial Commission in its meeting on 5 September 1953, approved the following Opinion.

Opinion 11.

1. *Shigella dysenteriae* (Shiga) Castellani and Chalmers 1919 was validly published and is legitimate as the name of the dysentery bacterium described by Shiga (1898).
2. The specific epithet *flexneri* in the species name *Shigella flexneri* Castellani and Chalmers 1919 is designated as a conserved specific epithet (epitheton specificum conservandum) for the species first described as *Bacillus dysenteriae* Flexner 1900.
3. The species name *Shigella boydii* Ewing 1949 was validly published and is legitimate. The specific epithet *boydii* in the species name *Shigella boydii* is to be conserved (epitheton specificum conservandum).
4. The species name *Shigella sonnei* (Levine) Weldin 1927 was validly published and is legitimate. The specific epithet *sonnei* in the species name *Shigella sonnei* is to be conserved (epitheton specificum conservandum).
5. A type or standard culture is to be designated by the Enterobacteriaceae Subcommittee of the International Committee on Bacteriological Nomenclature for each of the four species. Such cultures as far as possible shall be maintained in each of the national Type Culture Collections and in the International *Shigella* Center, Chamblee, Georgia, U. S. A.
6. A culture belonging to the species *Shigella flexneri*, *S. boydii* or *S. sonnei* could be completely identified by appending to the name "serotype" (with the appropriate designation).

REFERENCES

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OPINION 12

**Conservation of *Listeria* Pirie 1940 as a
Generic Name in Bacteriology**

Listerella Pirie 1927 was proposed as a bacterial generic name. When the attention of the author was called to the fact that *Listerella* Pirie was a later homonym of the generic name of a myxomycete, he (1940) proposed to replace *Listerella* by *Listeria*. This replacement has in general been accepted by those working in medical bacteriology. Becker (1951) noted that *Listeria* Pirie is a later homonym of *Listeria* Necker 1790 applied to a genus of flowering plants. Under the rules of the International Code of Nomenclature of Bacteria and Viruses *Listeria* Pirie is illegitimate. However, the suppression of both *Listerella* and *Listeria* as bacterial generic names would cause much confusion and resentment.

The generic name *Listeria* Necker was apparently validly published to include certain segregates from the genus *Oldenlandia* in the family *Rubiaceae*. The name has not been used by botanists since the time of its introduction (over a period of more than a century and a half). The Judicial Commission at its meeting on September 4, 1953, agreed to conserve *Listeria* Pirie 1930 as a generic name in bacteriology and approved the following opinion.

Opinion 12.

***Listeria* Pirie 1940 (type species *Listeria monocytogenes* (Murray, Webb, and Swann) Pirie 1940) shall be placed in the list of conserved names of bacterial genera (nomina generum conservanda).**

REFERENCES

- Becker, Elery R. The legitimacy of certain generic homonyms in bacteriology and protozoology. Internatl. Bull. Bact. Nomen. and Tax. 1 (3):103-112. 1951.
- Editorial Board. Status of *Listeria* Pirie 1940 as a generic name in bacteriology. Preliminary Statement. File 49. *Ibid.* 3 (2, 3):109-110. 1953.
- . Status of names of bacterial genera that are later homonyms of names of protozoan genera. Preliminary Statement. *Ibid.* 3 (2, 3):109-110. 1953.
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- . The genus *Listerella* Pirie. *Science* 91:383. 1940.

OPINION 13

**Conservation and Rejection of Names of Genera
of Bacteria Proposed by Trevisan 1842-1890**

Between the year 1842 and 1890 Trevisan proposed and for the most part validly published at least thirty-three new names for genera and subgenera of the bacteria. Some of these names have been accepted and have come into common use in bacteriology, others for one rea-

Appendix C. Opinion 13.

son or another, have been ignored and not employed. The evaluation and appropriate disposition of these names from the standpoint of their legitimacy is an important problem. As an aid to its solution, Trevisan's "Generi e le Specie delle Batteriacee" was photographically reproduced (1952). This paper was originally published as a separate brochure by the author; copies are rare (none known in America). The Editorial Board (1953) discussed the status of the several generic names proposed by Trevisan, and suggested a series of draft proposals as to their disposition. The Judicial Commission was asked to review these proposals and, as far as practicable, to fix the present status of each of the names. The Commission has placed the names in four groups. Those that can be adequately identified, have priority, and are in current use, are placed in the list of generic names to be conserved. Those that are later synonyms or homonyms are listed as illegitimate. Those that cannot be identified with reasonable definiteness are placed in the list of rejected generic names. The status of two names is left indeterminate and requiring more study. The Judicial Commission at its meeting of 5 September 1953 approved the following Opinion.

Opinion 13.

1. Generic names proposed by Trevisan placed in the list of conserved generic names (nomina generum conservanda).

| Names of Genera and Subgenera | Type Species |
|---|---|
| <i>Beggiatoa</i> Trevisan 1842 (p. 56) | <i>Beggiatoa alba</i> (Vaucher) Trevisan 1845 (<i>Oscillaria alba</i> Vaucher 1803) |
| <i>Klebsiella</i> Trevisan 1885 (p. 105) | <i>Klebsiella pneumoniae</i> (Schroeter) Trevisan 1887 (<i>Bacterium pneumoniae</i> <i>crouposae</i> Zopf 1885) |
| <i>Kurthia</i> Trevisan 1885 (p. 92) | <i>Kurthia zopfii</i> (Kurth) Trevisan 1885 (<i>Bacterium zopfii</i> Kurth 1883) |
| <i>Leptotrichia</i> Trevisan 1879 (p. 138) | <i>Leptotrichia buccalis</i> (Robin) Trevisan 1879. (<i>Leptothrix</i> <i>buccalis</i> Robin 1853) |
| <i>Neisseria</i> Trevisan 1885 (p. 105) | <i>Neisseria gonorrhoeae</i> Trevisan 1885 |
| <i>Pasteurella</i> Trevisan 1887 (p. 94) | <i>Pasteurella cholerae-gallinarum</i> Trevisan 1887 |

2. Generic names proposed by Trevisan placed in list of rejected generic names (nomina generum rejicienda).

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|---|--|
| <i>Babesia</i> Trevisan 1889 (p. 29) | <i>Babesia xanthopyretica</i> Trevisan 1889. |
|---|--|

| | |
|---|--|
| <i>Bacteriopsis</i> Trevisan 1885 (p. 103) | <i>Bacteriopsis rasmussenii</i> Trevisan 1885. (<i>Leptothrix</i> <i>xantopyreticus</i> Trevisan) |
| <i>Billetia</i> Trevisan 1889 (p. 11) | <i>Billetia laminariae</i> (Billet) Trevisan 1889. (<i>Bacterium</i> <i>laminariae</i> Billet 1888) |
| <i>Cenomesia</i> Trevisan 1889 (p. 1039) | <i>Cenomesia albida</i> Trevisan 1889 |
| <i>Cornilia</i> Trevisan 1889 (p. 21) | <i>Cornilia alvei</i> (Flügge) Trevisan 1889. (<i>Bacillus</i> <i>alvei</i> Flügge 1886) |
| <i>Dicoccia</i> Trevisan 1889 (p. 26) | <i>Dicoccia glossophila</i> Trevisan 1889 |
| <i>Eucornilia</i> Trevisan 1889 (p. 21) (Subgenus) | <i>Cornilia</i> (<i>Eucornilia</i>) <i>alvei</i> Trevisan 1889. (<i>Bacillus alvei</i> Cheshire and Cheyne 1885) |
| <i>Eumantegazzaea</i> Trevisan 1889 (p. 942) (Subgenus) | <i>Mantegazzaea</i> (<i>Eumantegaz-</i> <i>zaea</i>) <i>cienkowski</i> Trevisan 1879 |
| <i>Eupacinia</i> Trevisan 1889 (p. 23) (Subgenus) | <i>Pacinia</i> (<i>Eupacinia</i>) <i>putrifica</i> Trevisan 1889. (<i>Bacillus</i> <i>putrificus coli</i> Flügge 1886) |
| <i>Euspirillum</i> Trevisan 1879 (p. 24) (Subgenus) | <i>Spirillum</i> (<i>Euspirillum</i>) <i>undula</i> (Mueller) Ehrenberg 1830. (<i>Vibrio undula</i> Mueller 1773) |
| <i>Leptotrichiella</i> Trevisan 1889 (p. 935) (Subgenus) | <i>Leptotrichia</i> (<i>Leptotrichiella</i>) <i>amphibola</i> Trevisan 1889 |
| <i>Mantegazzaea</i> Trevisan 1889 (p. 137) | <i>Mantegazzaea cienkowski</i> Trevisan 1879 |
| <i>Octopsis</i> Trevisan 1885 (p. 102) | <i>Octopsis cholerae-gallinarum</i> Trevisan 1885. (<i>Micrococcus</i> <i>cholerae-gallinarum</i> Zopf 1885) |
| <i>Perroncitoa</i> Trevisan 1889 (p. 29) | <i>Perroncitoa scarlatinosa</i> (Trevisan) Trevisan 1889. (<i>Micrococcus scarlatinus</i> Trevisan 1879) |
| <i>Pleurospora</i> Trevisan 1889 (p. 22) (Subgenus) | <i>Cornilia</i> (<i>Pleurospora</i>) <i>tremula</i> (Koch) Trevisan 1889. (<i>Bacillus tremulus</i> Koch 1877) |
| <i>Pseudospira</i> Trevisan 1889 (p. 23) (Subgenus) | <i>Pacinia</i> (<i>Pseudospira</i>) <i>cholerae-</i> <i>asiaticae</i> Trevisan 1885. (<i>Vibrio cholerae</i> Pacini 1854) |
| <i>Pseudospirillum</i> Trevisan 1889 (p. 25) (Subgenus) | <i>Spirillum</i> (<i>Pseudospirillum</i>) <i>amphibolum</i> Trevisan 1889 |

Appendix C. Opinion 13.

3. Trevisan's generic names which, as later homonyms or synonyms, are regarded as illegitimate.

| | |
|--|---|
| <i>Bollingeria</i> Trevisan 1889 (p. 26) | <i>Bollingeria equi</i> (Rivolta) Trevisan 1889. (<i>Zoogloea pulmonis equi</i> Bollinger 1870) |
| <i>Rasmussenia</i> Trevisan 1889 (p. 930) | <i>Rasmussenia buccalis</i> (Robin) Trevisan 1889. (<i>Leptothrix buccalis</i> Robin 1853) |
| <i>Schuetzia</i> Trevisan 1889 (p. 29) | <i>Schuetzia poelsii</i> Trevisan 1889. (<i>Streptococcus equi</i> Sand and Jensen 1888) |
| <i>Winogradskya</i> Trevisan 1889 (p. 12) | <i>Winogradskya ramigera</i> (Itzigsohn) Trevisan 1889. (<i>Zoogloea ramigera</i> Itzigsohn 1867) |

4 Trevisan's generic names whose status is indeterminate.

| | |
|--|--|
| <i>Gaffkya</i> Trevisan 1885 (p. 105) | <i>Gaffkya tetragena</i> (Gaffky) Trevisan 1885. (<i>Micrococcus tetragenus</i> Gaffky 1883) |
| <i>Pacinia</i> Trevisan 1885 (p. 83) | <i>Pacinia cholerae-asiaticae</i> Trevisan 1885 |

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OPINION 14

Names of Bacterial Genera to be Rejected as later Homonyms of Names of Genera of Protozoa

Becker (1951) listed the generic homonyms in bacteriology and protozoology. He found that ten bacterial generic names proposed (one of them, *Astasia*, independently for two different bacterial genera) are later homonyms of names of protozoan genera. He suggested that these bacterial generic names should be rejected in bacteriology. The Editorial Board (1953) proposed that these names be considered by the Judicial Commission for possible inclusion in the list of names of bacterial genera to be rejected. The proposal has been considered by the Judicial Commission and the following Opinion approved.

Opinion 14.

The following names proposed for bacterial genera are found to be later homonyms of names applied to genera of protozoa. Rule 24 of the International Code of Nomenclature of Bacteria and Viruses states that such later homonyms are illegitimate in bacteriology. These names are to be placed in the list of names of bacterial genera to be rejected (nomina generum bacteriorum rejicienda).

| Rejected Names of Bacterial Genera | Names of Protozoan Genera Having Priority |
|--|--|
| <i>Astasia</i> Meyer 1897 | <i>Astasia</i> Ehrenberg 1830 |
| <i>Astasia</i> Pribram 1929 | |
| <i>Castellanella</i> Pacheco and Rodrigues 1930 | <i>Castellanella</i> Chalmers 1918 |
| <i>Charon</i> Holmes 1948 | <i>Charon</i> Karsch 1879 |
| <i>Coccomonas</i> Orla-Jensen 1921 | <i>Coccomonas</i> Stein 1878 |
| <i>Listerella</i> Pirie 1927 | <i>Listerella</i> Jahn 1906 |
| <i>Palmula</i> Prévot 1938 | <i>Palmula</i> Lea 1833 |
| <i>Pfeifferella</i> Buchanan 1918 | <i>Pfeifferella</i> Labbé 1899 |
| <i>Phytomonas</i> Bergey <i>et al.</i> 1923 | <i>Phytomonas</i> Donovan 1909 |
| <i>Rhizomonas</i> Orla-Jensen 1909 | <i>Rhizomonas</i> Kent 1880 |
| <i>Rhodosphaera</i> Buchanan 1918 | <i>Rhodosphaera</i> Haeckel 1881 |

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OPINION 15

**Conservation of the Family Name Enterobacteriaceae,
of the Name of the Type Genus, and Designation of the Type Species**

The Editorial Board of the Judicial Commission published a statement relative to a proposal that the family name *Enterobacteriaceae* Rahn 1937 be conserved, that the type genus be designated, that the name of the type genus be conserved, and that the type species be designated. The Commissioners were requested to vote by ballot on the several proposals.

The result of the vote authorizes the Editorial Board acting for the Judicial Commission to publish the following Opinion. This Opinion is final unless revoked or modified by action of the International Committee on Bacteriological Nomenclature.

Opinion 15.

1. **The family name Enterobacteriaceae Rahn 1937 (p. 280) is placed in the list of conserved family names (nomina conservanda familiarum).**
2. **The genus Escherichia Castellani and Chalmers 1919 (p. 941) is designated as the type genus of the family Enterobacteriaceae Castellani and Chalmers 1919.**
3. **The generic name Escherichia Castellani and Chalmers 1919 (p. 941) is placed in the list of conserved generic names (nomina conservanda generum).**
4. **The type species of the genus Escherichia Castellani and Chalmers 1919 (p. 941) is Escherichia coli (Migula) Castellani and Chalmers 1919 (p. 941), (basonym Bacillus coli Migula 1895 (p. 27); hyponym Bacterium coli commune Escherich 1885 (p. 518)).**

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APPENDIX D

*Conserved and Rejected Names
of Taxa*

APPENDIX D

Conserved and Rejected Names of Taxa

Nomina Taxorum Conservanda et Rejicienda

The International Code of Nomenclature of Bacteria and Viruses provides for publication of lists of names of taxa of the several ranks which are to be conserved or rejected.

The conserved and rejected names and specific epithets approved to January, 1958, are here listed in five tables.

Table I. Conserved and rejected family names.

Table II. Conserved names of genera of bacteria.

Table III. Conserved specific epithets in names of species of bacteria.

Table IV. Rejected names of genera of bacteria and viruses.

Table V. Rejected names of subgenera.

TABLE I
CONSERVED AND REJECTED FAMILY NAMES

| <u>Nomina familiarum conservanda et rejicienda</u> | | | | |
|--|--|------------------------------------|--------------------------|---|
| Conserved Name Nomen Conservandum | Name of Type Genus of Conserved Family | Rejected Name Nomen Rejiciendum | Opinions No. and Date | Citations (I.B. #) |
| <u>Enterobacteriaceae</u> Rahn 1957, p. 280. | <u>Escherichia</u> Gas- tellani and Chalmers 1919, p. 641. | <u>Bacteriaceae</u> | No. 15, 1958. | 5:74 1958. 3:127. 1953. 3:149. 1953. 3:153. 1953. 3:159. 1953. 7:165. 1957. 8:75. 1958. |

*I.B.-International Bulletin of Bacteriological Nomenclature and Taxonomy.
Iowa State College Press Ames, Iowa. U.S.A.

TABLE II
CONSERVED NAMES OF GENERA OF BACTERIA
Nomina generum bacteriorum conservanda

| Conserved generic names Nomina generum conservanda | Name of Type Species of Conserved Genus | Opinions No. and Date | Citations (t. B.)* |
|---|--|--------------------------|---|
| <u>Bacillus</u> Cohn 1872 | <u>Bacillus subtilis</u> Cohn 1872. | A, 1936 | Proc. 2nd Internat. Congr. Microbiol., London, 1936 |
| <u>Beggiatoa</u> Trevisan 1842 | <u>Beggiatoa alba</u> (Vaucher) Trevisan 1845 (<u>Beggiatoa punctata</u> Trevisan 1842, <u>Oscillatoria alba</u> Vaucher 1803). | No. 13, 1953 | 3:88. 1953 4:152. 1954 |
| <u>Escherichia</u> Castellani and Chalmers 1919 | <u>Escherichia coli</u> (Migula) Castellani and Chalmers 1919 (basonym <u>Bacillus coli</u> Migula 1895, <u>hyponym</u> <u>Bacterium coli commune</u> Escherich 1885). | No. 15, 1958 | 3:151. 1953 3:74. 1953 3:159. 1953 3:127. 1953 7:165. 1957 3:149. 1953 8:73. 1958 7:153. 1953 |
| <u>Gallionella</u> Ehrenberg 1838 | <u>Gallionella ferruginea</u> Ehrenberg 1838 (<u>Gaillonella ferruginea</u> Ehrenberg 1836, <u>Didymohelix ferruginea</u> (Ehrenberg) Griffith 1853). | No. 9, 1953 | 2:96. 1952 3:150. 1953 3:81. 1953 4:156. 1954 |
| <u>Klebsiella</u> Trevisan 1885 | <u>Klebsiella pneumoniae</u> (Schroeter) Trevisan 1887 (<u>Bacterium pneumoniae-crouposae</u> Zopf 1885, <u>Klebsiella crouposa</u> Trevisan 1885, <u>Hyalococcus pneumoniae</u> Flugge 1886). | No. 13, 1953 | 1:106. 1951 4:152. 1954 |
| <u>Kurtzia</u> Trevisan 1885 | <u>Kurtzia zopfii</u> (Kurtz) Trevisan 1885 (<u>Bacterium zopfii</u> Kurtz 1883, <u>Helikobacterium zopfii</u> Escherich 1886, <u>Zopfius zopfii</u> Wenner and Rettger 1919). | No. 13, 1953 | 7:95. 1953 4:152. 1954 |
| <u>Leptotrichia</u> Trevisan 1879 | <u>Leptotrichia buccalis</u> (Robin) Trevisan 1879 (<u>Leptothrix buccalis</u> Robin 1853). | No. 13, 1953 | 3:151. 1953 4:152. 1954 |
| <u>Listeria</u> Pirie 1940 | <u>Listeria monocytogenes</u> (Murray, Webb and Swann) Pirie 1940 (<u>Bacterium monocytogenes</u> Murray, Webb and Swann 1926, <u>Listerella hepatolytica</u> Pirie 1927). | No. 13, 1953 | 2:96. 1953 3:151. 1953 |
| <u>Neisseria</u> Trevisan 1885 | <u>Neisseria gonorrhoeae</u> (Zopf) Trevisan 1885 (<u>Merisnopia gonorrhoeae</u> Zopf 1885, <u>Micrococcus gonorrhoeae</u> Flugge 1886, <u>Micrococcus gonococcus</u> Schroeter 1886, <u>Diplococcus gonorrhoeae</u> Lehmann and Neumann 1896). | No. 13, 1953 | 3:85. 1953 4:154. 1954 |
| <u>Nocardia</u> Trevisan 1889 | <u>Nocardia farcinica</u> Trevisan 1889 (<u>Streptothrix farcinica</u> Rossi Doria, <u>Actinomyces farcinicus</u> Gasperi 1892, <u>Oospora farcinica</u> Sauvageau and Radais 1892, <u>Streptothrix farcini</u> bovis Kitt 1899, <u>Bacterium nocardii</u> Migula 1900, <u>Streptothrix nocardii</u> 1901, <u>Discomyces farcinicus</u> Gadoelst 1902, <u>Actinomyces nocardii</u> Buchanan 1911, <u>Nocardia alba</u> Chalmers and Christopherson 1916). | No. 13, 1953 | 3:98. 1953 3:151. 1953 4:153. 1954 |
| <u>Pasteurella</u> Trevisan 1887 | <u>Pasteurella cholerae</u> gallinarum Trevisan 1887 (<u>Coccobacillus avicidus</u> Gamaleia 1888, <u>Pasteurella avicida</u> Trevisan 1885, <u>Micrococcus cholerae</u> gallinarum Zopf 1885, <u>Micrococcus gallicidus</u> Burrill 1883). | No. 13, 1953 | 2:98. 1953 3:151. 1953 4:153. 1954 |
| <u>Pseudomonas</u> Migula 1894 | <u>Pseudomonas aeruginosa</u> (Schroeter) Migula 1900 (<u>Bacterium aeruginosum</u> Schroeter 1873, <u>Bacillus pyocyanus</u> Gessard 1882, <u>Pseudomonas pyocyanus</u> (Gessard) Migula 1895). | No. 5, 1954 | 1:41. 1951 3:75. 1953 7:121. 1952 |

*t. B. - International Bulletin of Bacteriological Nomenclature and Taxonomy. Iowa State College Press. Ames, Iowa. U.S.A.

Appendix D. Conserved Specific Epithets

TABLE III
 CONSERVED SPECIFIC EPITHETS IN NAMES OF SPECIES OF BACTERIA

Epitheta specifica conservanda

| Conserved specific epithets <u>Epitheta specifica conservanda</u> | Name of species in which specific epithet is conserved | Opinions No. and Date | Citation (I.B.) ^a |
|--|---|--------------------------|---|
| <u>agalactiae</u> | <u>Streptococcus agalactiae</u> Lehmann and Neumann 1896 (<u>Streptococcus</u> <u>nocardi</u> Trevisan 1889, <u>Streptococcus agalactiae</u> <u>contagiosus</u> Kitt 1894, <u>Streptococcus mastitidis</u> Migula 1900). | No. 8, 1953 | 2:104, 1952 3:21, 1953 3:79, 1953 4:145, 1954 |
| <u>boydii</u> | <u>Shigella boydii</u> Ewing 1949. | No. 11, 1953 | 1:147, 1951 1:150, 1951 1:158, 1951 3:150, 1953 4:148, 1954 |
| <u>dysenteriae</u> | <u>Shigella dysenteriae</u> (Shiga) Castellani and Chalmers 1919. | No. 11, 1953 | 1:147, 1951 1:150, 1951 1:158, 1951 3:150, 1953 4:148, 1954 |
| <u>flexneri</u> | <u>Shigella flexneri</u> (Flexner) Castellani and Chalmers 1919 (<u>Bacillus dysenteriae</u> Flexner 1900). | No. 11, 1953 | 1:147, 1951 1:150, 1951 1:158, 1951 3:150, 1953 4:148, 1954 |
| <u>sonnei</u> | <u>Shigella sonnei</u> (Levine) Weldon 1927 (<u>Bacterium sonnei</u> Levine 1920, <u>Proshigella sonnei</u> Borman, Stewart and Wheeler 1944). | No. 11, 1953 | 1:147, 1951 1:150, 1951 1:158, 1951 3:150, 1953 4:148, 1954 |

^aI.B. - International Bulletin of Bacteriological Nomenclature and Taxonomy. Iowa State College Press, Ames, Iowa U.S.A.

TABLE IV
REJECTED NAMES OF GENERA OF BACTERIA AND VIRUSES
Nomina generum bacteriorum et virus rejecta

| Rejected generic names <i>Nomina generum rejicienda</i> | Name of type species of rejected genera | Reasons for rejection of generic names | Opinions No. and Date | Citations (I.B.) |
|--|---|---|--------------------------|--|
| <i>Astasia</i> Meyer 1897 | <i>Astasia asterospora</i> Meyer 1897. | Later homonym of <i>Astasia Ehrenberg</i> 1830 (<i>Protozoa</i>). | No. 14, 1953 | 1:104, 1951 3:109, 1953 4:157, 1954 |
| <i>Astasia</i> Pribram 1929 | None named. No species. | Not validly published. No species listed. Also later homonym of protozoan generic name <i>Astasia</i> . | No. 14, 1953 | 1:104, 1951 3:109, 1953 4:157, 1954 |
| <i>Babesia</i> Trevisan 1889 | <i>Babesia xanthopyrethica</i> Trevisan 1889, (<i>Siroptococcus xanthopyrethicus</i> Trevisan 1889). | The later homonym <i>Babesia Sarcovici</i> 1893 is in common use as the name of a protozoan genus. Nomen genericis rejiciendum. Nomen confusum. | No. 13, 1953 | 1:104, 1951 1:387, 1953 3:111, 1953 4:153, 1954 |
| <i>Bacteriopsis</i> Trevisan 1885 | <i>Bacteriopsis rasmussenii</i> Trevisan 1885 (<i>Leptothrix</i> I Rasmussen 1883, <i>Bacillus rasmussenii</i> Trevisan 1889, <i>Rasmussenia anceps</i> Trevisan 1889). | Nomen genericis rejiciendum. Nomen confusum. | No. 13, 1953 | 3:88, 1953 3:151, 1953 4:153, 1954 |
| <i>Billetia</i> Trevisan 1889 | <i>Billetia laminariae</i> (Billet) Trevisan 1889 (<i>Bacterium laminariae</i> Billet 1888, <i>Kurthia laminariae</i> (Billet) Trevisan 1889). | Nomen genericis rejiciendum. Nomen dubium. | No. 13, 1953 | 3:89, 1953 3:151, 1953 4:153, 1954 |
| <i>Bollingeria</i> Trevisan 1889 | <i>Bollingeria equi</i> (Rivolta and Micellone) Trevisan 1889 (<i>Zoogloea pulmonis equi</i> Bollinger 1879, <i>Discomyces equi</i> Rivolta and Micellone 1878, <i>Micrococcus ascoformans</i> Johne 1865, <i>Micrococcus bovis</i> genus Rabe 1887, <i>Botryomyces equi</i> Bollinger 1887, <i>Botryomyces ascoformans</i> Kitt 1888, <i>Staphylococcus ascoformans</i> Ford 1927, <i>Staphylococcus aureus</i> var. <i>equi</i> (Bollinger) Hauduroy et al. 1937). | Nomen genericis rejiciendum. Nomen dubium. | No. 13, 1953 | 3:90, 1953 3:151, 1953 4:154, 1954 |

Appendix D. Rejected Names of Genera

| | | | |
|---|--|--|--|
| <u>Castellanella Pacheco and Rodrigues 1930</u> | <u>Castellanella alcalescens (Andrewes) Pacheco and Rodrigues 1930 (Bacillus alcalescens Andrewes 1918, Shigella alcalescens (Andrewes) Weldon 1927).</u> | Illegitimate later homonym of <u>Castellanella Chalmers 1918 (Protozoa)</u> . Nomen generis rejiciendum. | <u>1:105, 1951</u> <u>3:109, 1953</u> <u>4:157, 1954</u> |
| <u>Genomesia Trevisan 1889</u> | <u>Genomesia albida Trevisan 1889.</u> | Nomen generis rejiciendum. Nomen dubium. | <u>3:91, 1953</u> <u>3:151, 1953</u> <u>4:153, 1954</u> |
| <u>Charon Holmes 1948</u> | <u>Charon evagatus Holmes 1948.</u> | Illegitimate later homonym of <u>Charon Jameson 1925 (Protozoa)</u> . Nomen generis rejiciendum. | <u>1:106, 1951</u> <u>3:109, 1953</u> <u>4:157, 1954</u> |
| <u>Chlorobacterium Guttlebein 1890</u> | <u>Chlorobacterium luctis Guttlebein 1890.</u> | Rejected as an earlier homonym to make legitimate the later homonym <u>Chlorobacterium Lauterborn 1915</u> . Nomen generis rejiciendum. | <u>1:43, 1951</u> <u>3:77, 1953</u> <u>3:149, 1953</u> <u>4:143, 1954</u> |
| <u>Coccomonas Orla-Jensen 1921</u> | None named. No species. | Provisional name only. Not validly published. Later illegitimate homonym of <u>Coccomonas Stein 1878 (Protozoa)</u> . Nomen generis rejiciendum. | <u>1:106, 1951</u> <u>3:109, 1953</u> <u>4:157, 1954</u> |
| <u>Cornelia Trevisan 1889</u> | <u>Cornelia alvei (Flügge) Trevisan 1889 (Bacillus alvei) Cheyne and Cheyne 1885).</u> | Nomen generis rejiciendum. | <u>3:92, 1953</u> <u>3:151, 1953</u> <u>4:153, 1954</u> |
| <u>Dicoccia Trevisan 1889</u> | <u>Dicoccia glossophida Trevisan 1889.</u> | Nomen generis rejiciendum. | <u>3:93, 1953</u> <u>3:151, 1953</u> |
| <u>Didemobelix Griffith 1853</u> | <u>Didemobelix ferruginea (Ehrenberg) Griffith 1853 (Gallionella ferruginea Ehrenberg 1836).</u> | Later synonym of <u>Gallionella Ehrenberg 1836</u> with same type species. Nomen generis rejiciendum. | <u>4:153, 1954</u> <u>2:96, 1952</u> <u>3:80, 1953</u> <u>3:150, 1953</u> |
| <u>Donovania Anderson, de Monbreun and Goodpasture 1944</u> | <u>Donovania granulomatis Anderson, de Monbreun and Goodpasture 1944 (Calymmatobacterium granulomatis Aragão and Vianna 1913, Encapsulatus inguinatus Bergey et al. 1923, Klebsiella granulomatis Bergey et al. 1925).</u> | Later illegitimate synonym of <u>Calymmatobacterium Aragão and Vianna 1913</u> . Nomen generis rejiciendum. | <u>4:146, 1954</u> <u>3:17, 1953</u> <u>4:144, 1954</u> |

I. B. - International Bulletin of Bacteriological Nomenclature and Taxonomy. Iowa State College Press. Ames, Iowa, U.S.A.

Table IV (continued)

| Rejected generic names Nomina generum rejicienda | Name of type species of rejected genus | Reason for rejection of generic name | Opinions No. and Date | Citations (I, B) % |
|---|--|--|--------------------------|--|
| <u>Listerella</u> Pirie 1927 | <u>Listerella hepatolytica</u> Pirie 1927 (<u>Bacterium monocytogenes</u> Murray, Webb and Swann 1926). | Illegitimate later homonym of <u>Listerella</u> Jahn 1906 (<u>Myxomycetes</u>). Nomen generis rejiciendum. | No. 14, 1953 | 1:107, 1951 3:109, 1953 3:151, 1953 |
| <u>Mantegazzaea</u> Trevisan 1889 | <u>Mantegazzaea cienkowski</u> Trevisan 1879 (<u>Bacterium articulatum</u> Ehrenberg 1830). | Nomen generis rejiciendum. Nomen dubium. | No. 13, 1953 | 4:157, 1954 4:157, 1953 3:98, 1953 3:151, 1953 |
| <u>Mullerina</u> de Petschenko 1910 | <u>Mullerina paramedii</u> de Petschenko 1910 (<u>Drepanospira muelleri</u> de Petschenko 1911). | Not accepted by author, not validly published. Replaced by <u>Drepanospira</u> de Petschenko 1911. Nomen generis rejiciendum. | No. 10, 1953 | 4:153, 1954 2:9, 1952 3:81, 1953 4:147, 1954 |
| <u>Octopsis</u> Trevisan 1885 | <u>Octopsis cholerae gallinarum</u> Trevisan 1885 (<u>Micrococcus cholerae gallinarum</u> Zopf 1885). | "Tentatively" proposed, and not later used by author. Nomen generis rejiciendum. | No. 13, 1953 | 3:99, 1953 3:151, 1953 4:153, 1954 |
| <u>Palmula</u> Prévot 1938 | <u>Palmula spermoides</u> (Ninni) Prévot. | Illegitimate later homonym of <u>Palmula</u> Lea 1833 (<u>Protozoa</u>). Nomen generis rejiciendum. | No. 14, 1953 | 1:107, 1951 3:109, 1953 3:151, 1953 |
| <u>Perronctoa</u> Trevisan 1889 | <u>Perronctoa scarlatinosa</u> (Trevisan) Trevisan 1889 (<u>Micrococcus scarlatinosus</u> Trevisan 1879, <u>Sireptococcus rubiginosus</u> Edington 1887). | Nomen generis rejiciendum. Nomen dubium. | No. 13, 1953 | 4:157, 1954 3:101, 1953 3:151, 1953 3:154, 1954 |
| <u>Pfeifferella</u> Buchanan 1918 | <u>Pfeifferella mallei</u> (Zopf) Buchanan 1918 (<u>Bacillus mallei</u> Zopf 1885, <u>Bacterium</u> <u>mallei</u> (Zopf) Migula 1895, <u>Corynebacter-</u> <u>ium mallei</u> Lehmann and Neumann 1899, <u>Mycobacterium mallei</u> Chester 1901, <u>Cladascus mallei</u> Enderlein 1917, <u>Sclero-</u> <u>thrix mallei</u> Vuillemin 1931, <u>Brucella mallei</u> Pacheco 1933, <u>Actinobacillus mallei</u> Thompson 1933, <u>Loefflerella mallei</u> Gay et al. 1935). | Illegitimate later homonym of <u>Pfeifferella</u> Labbé 1899. Nomen generis rejiciendum. | No. 14, 1953 | 1:108, 1951 3:109, 1953 3:151, 1953 |

Appendix D. Rejected Names of Genera

| | | No. 14, 1953 | 1:108, 1951 3:110, 1953 3:152, 1953 4:157, 1954 |
|--------------------------------------|---|---|--|
| <u>Phytomonas</u> Bergey et al. 1923 | <u>Phytomonas campestris</u> (Pammel) Bergey et al. 1923 (<u>Bacillus campestris</u> Pammel 1895, <u>Pseudomonas campestris</u> E. F. Smith 1897, <u>Bacterium campestris</u> Chester 1897, <u>Xanthomonas campestris</u> (Pammel) Dowson 1939). | Illegitimate later homonym of <u>Phytomonas</u> Donovan 1909. Nomen generis rejiciendum. | |
| <u>Rasmussenia</u> Trevisan 1889 | <u>Rasmussenia buccalis</u> (Robin and Lebert) Trevisan 1889 (<u>Leptothrix buccalis</u> Robin 1953, <u>Leptothrix buccalis</u> (Robin) Trevisan 1879). | Illegitimate later synonym of <u>Leptothrix</u> Trevisan 1879 with same type species. Nomen generis rejiciendum. | 3:103, 1953 3:151, 1953 4:154, 1954 |
| <u>Rhizomonas</u> Orla-Jensen 1909 | None named. No species. | Illegitimate later homonym of <u>Rhizomonas</u> Kent 1880 (Protozoa). Not validly published. Nomen generis rejiciendum. | 1:109, 1951 4:157, 1954 |
| <u>Rhodospira</u> Buchanan 1918 | <u>Rhodospira capsulatus</u> (Molisch) Buchanan 1918. | Illegitimate homonym of <u>Rhodospira</u> Haackel 1881 (Protozoa). Nomen generis rejiciendum. | 1:109, 1951 3:110, 1953 3:152, 1953 4:157, 1954 |
| <u>Winogradskyia</u> Trevisan 1889 | <u>Winogradskyia ramigera</u> (Itzigsohn) Trevisan 1889 (<u>Zoogloea ramigera</u> Itzigsohn 1867). | Illegitimate as later synonym of <u>Zoogloea</u> Itzigsohn 1867 with same type species. Nomen generis rejiciendum. | 3:103, 1953 3:151, 1953 4:154, 1954 |

*I. B. - International Bulletin of Bacteriological Nomenclature and Taxonomy. Iowa State College Press. Ames, Iowa, U.S.A.

TABLE V
REJECTED NAMES OF SUBGENERA
Nomina subgenerum rejicienda

| Rejected names of subgenera Nomina subgenerum rejicienda | Names of type species of rejected subgenera | Reasons for rejection of subgeneric names | Opinions No. and Date | Citations (I.B.) ^a |
|---|---|--|--------------------------|---|
| <u>Eucornilia</u> Trevisan 1889 | <u>Cornilia</u> (<u>Eucornilia</u>) <u>alvei</u> (Cheshire and Cheyne) Trevisan 1889 (<u>Bacillus alvei</u> Cheshire and Cheyne 1885) | Illegitimate as it included type species of <u>Cornilia</u> Trevisan 1889. Nomen subgeneris rejiciendum. | No. 13, 1953 | 3:93, 1953 3:151, 1953 4:153, 1954 |
| <u>Eumantegazzaea</u> Trevisan 1889 | <u>Mantegazzaea</u> (<u>Eumantegazzaea</u>) <u>cienkowskii</u> Trevisan 1889. | Nomen subgeneris rejiciendum. Nomen dubium. | No. 13, 1953 | 3:93, 1953 3:151, 1953 4:153, 1954 |
| <u>Eupacina</u> Trevisan 1889 | <u>Pacina</u> (<u>Eupacina</u>) <u>putrificans</u> Trevisan 1889 <u>Bacillus putrificans</u> coli Flugge 1886). | Nomen subgeneris rejiciendum. Nomen confusum. | No. 13, 1953 | 3:94, 1953 3:151, 1953 4:153, 1954 |
| <u>Euspirillum</u> Trevisan 1889 | <u>Spirillum</u> (<u>Euspirillum</u>) <u>undula</u> (Mueller) Trevisan 1889 (<u>Vibrio undula</u> Mueller 1773). | Illegitimate as containing type species of the genus. Nomen subgeneris rejiciendum. | No. 13, 1953 | 3:94, 1953 3:151, 1953 4:153, 1954 |
| <u>Leptotrichiella</u> Trevisan 1889 | <u>Leptotrichia</u> (<u>Leptotrichiella</u>) <u>amphibola</u> Trevisan 1889 (<u>Streptomesobacterio</u> Maggi 1889). | Nomen subgeneris rejiciendum. Nomen dubium. | No. 13, 1953 | 3:97, 1953 3:151, 1953 4:153, 1954 |
| <u>Pleurospora</u> Trevisan 1889 | <u>Cornilia</u> (<u>Pleurospora</u>) <u>tremula</u> (Koch) Trevisan 1889 (<u>Bacillus tremulus</u> Koch 1877). | Nomen subgeneris rejiciendum. Nomen dubium. | No. 13, 1953 | 3:102, 1953 3:151, 1953 4:154, 1954 |
| <u>Pseudospira</u> Trevisan 1889 | <u>Pacina</u> (<u>Pseudospira</u>) <u>cholerae asiaticae</u> Trevisan 1889 (<u>Vibrio cholerae</u> erroneously ascribed to Pacini by Trevisan 1889). | Illegitimate, includes type species of genus. Nomen subgeneris rejiciendum. | No. 13, 1953 | 3:102, 1953 3:151, 1953 4:154, 1954 |
| <u>Pseudospirillum</u> Trevisan 1889 | <u>Spirillum</u> (<u>Pseudospirillum</u>) <u>amphibolum</u> Trevisan 1889. | Nomen subgeneris rejiciendum. Nomen dubium. | No. 13, 1953 | 3:102, 1953 3:151, 1953 4:154, 1954 |

^aI.B.—International Bulletin of Bacteriological Nomenclature and Taxonomy. Iowa State College Press. Ames, Iowa, U.S.A.

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